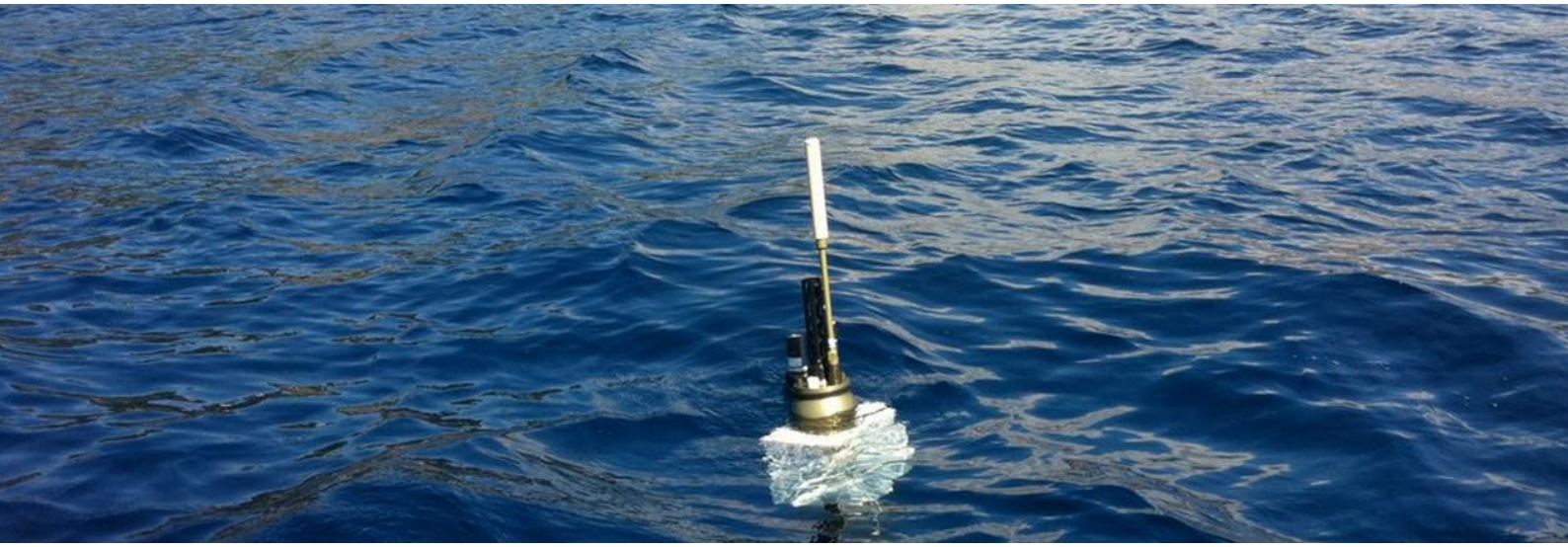
APMT Profiler - Parameter set

AUTOMATED **M**ULTI-**T**ASK **P**ROFILER



33-16-048_APMT_Parameter_Set
Revision 1.2 (2020-05-13)

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1. Revision history

Revision	Release date	Notes	Author
1.0	2018-03-13	Original	C. SCHAEFFER
1.1	2019-12-06	Adding USEA parameters	C. SCHAEFFER
1.2	2020-05-13	Adding “USEA”, “Ice Avoidance” and “Multi-Parking” navigation script	C. SCHAEFFER

2. Parameter setting

2.1 Configuration file

Parameter setting of the float is performed using a configuration file "apmt_update.ini". This file is organized in sections. Each section contains keys from P0 to Px.

2.2 List of parameters

[SYSTEM]

No.	Comment	Limitation
0	Mission description script	128 characters
1	Event log level of detail	[0-2]
2	Decimal and column separators for data files (*.csv)	[./,] and [<space>/;]
3	IP address of the float on a local connection via Bluetooth	xxx.xxx.xxx.xxx
4	System task list: 0 – Float Integrity Test 1 – SBE41 navigation sensor 2 – Float safety mechanisms 3 – Standard navigation control 4 – Payload interaction 5 – GPS positioning 6 – Sensor acquisition 7 – NOSS navigation sensor 8 – SDA14 acoustic noise sensor 9 – Special mechanisms 10 – PUCK sensor 11 – EMAP sensor 12 – USEA interaction 13 – Under-ice capabilities	0;1;2;3;5;6;9;12
5	Enable/disable "user" trace files	[True/False]
6	Enable/disable "system" trace files	[True/False]
7	Enable/disable complete self-test	[True/False]
8	Feedback-related risk criterion	[0-4]
9	Maximum buoyancy recovery	[True/False]
10	External pressure offset after effective surface only	[True/False]
11	Time stamping format for data files (*.csv)	[0-3]
12	Mandatory additional memory card for the mission	[True/False]

[TECHNICAL]

No.	Comment	Limitation
0	Rate of descent threshold for SV action (cm/s)	[0.5-2.0]
1	Rate of ascent threshold for pump action (cm/s)	[5.0-10.0]
2	Typical rate of descent (cm/s)	[1.0-5.0]
3	Typical rate of ascent (cm/s)	[5.0-10.0]
4	Pressure tolerance for positioning in descent (dbar)	[2-100]
5	Pressure tolerance for positioning in ascent (dbar)	[2-100]
6	Pressure tolerance before repositioning in park (dbar)	[2-100]
7	Pressure tolerance for positioning in park (dbar)	[2-100]
8	Pressure monitoring period during descent (s)	[60-600]

9	Pressure monitoring period during ascent (s)	[60-600]
10	Pressure monitoring period during drift (s)	[600-3600 (1 hr)]
11	Maximum volume of an SV action during descent/repositioning (cm3)	[1.0-30.0]
12	Maximum volume of a pump action during repositioning (cm3)	[1.0-30.0]
13	Emergence reduction threshold 1 (dbar)	[0.1-2.0]
14	Emergence reduction threshold 2 (dbar)	[0.5-10.0]
15	Fixed volume of a pump action during ascent (cm3)	[1.0-30.0]
16	Fixed volume of a pump action during braking (cm3)	[1.0-10.0]
17	SV activation time during phase 2 of emergence reduction (cs)	[1000-5000]
18	SV activation factor during phase 2 of emergence reduction	[1.0-5.0]
19	Fixed emergence volume (cm3)	[400.0-1500.0]
20	End of ascent detection threshold (dbar)	[5-20]
21	Deceleration during ascent (0 = none, 1 = low, 5 = high)	[0-5]
22	Braking power in ascent abortion (multiplies P15)	[1.0-4.0]

[PATTERN_XX]

No.	Comment	Limitation
0	Enable/disable pattern	[True/False]
1	"Parking" drift depth (dbar)	[100-2000]
2	"Measurement" drift depth (dbar)	[100-2000]
3	Pattern duration (s)	[0-2419200 (28 days)]
4	Time of presence at the surface	hh:mm:ss
5	Enable/disable GPS position acquisition	[True/False]
6	Enable/disable transmission session	[True/False]
7	Enable/disable surface presence synchronization	[True/False]

[ALARM]

No.	Comment	Limitation
0	Low battery voltage detection threshold (V)	[9.0-11.5]
1	High internal pressure detection threshold (mbar)	[700.0-1100.0]
2	Detection threshold for inconsistent external pressure jumps (cm/s)	[30.0-100.0]
3	Low external pressure detection threshold (dbar)	[-10.0 to -1.0]
4	Detection threshold for high external pressure / pressure limit (dbar)	[500-2100]
5	Detection of broken external pressure sensor (successive errors)	[5-15]
6	Information: Power-on detection	System restricted
7	Information: Detection of invalid configuration	System restricted
8	Information: Detection of "system" failure	System restricted
9	Detection threshold for grounding during descent (cm3)	[50.0-1000.0]
10	Detection threshold for hanging during ascent (cm3)	[100.0-2500.0]
11	Information: "Survival" procedure initiated	System restricted
12	Information: Detection of "payload" failure	System restricted
13	Information: Detection of "GPS" failure	System restricted
14	Information: "End of life" procedure initiated	System restricted
15	Information: Detection of "hydraulic" failure	System restricted
16	Detection of high rate of descent (braking)	[5.0-30.0]
17	Information: Detection of failure during external pressure offset	System restricted
18	Information: Detection of deployment with "float too heavy"	System restricted
19	Information: Detection of deployment with "float too light"	System restricted
20	Information: "Feedback" procedure initiated	System restricted

21	Low battery voltage detection threshold (min. on pump) (V)	[7.0-11.5]
22	Information: Detection of "ADC" failure	System restricted
23	Information: Detection of ice via "ISA" algorithm	System restricted
24	Information: Detection of corrupted measurement file	System restricted
25	Information: Detection of "RTC" failure	System restricted
26	Information: Detection of pressure switch activation	System restricted
27	Information: Detection of "SDA14" failure	System restricted
28	Information: Detection of water in the float	System restricted

[TEMPORIZATION]

No.	Comment	Limitation
0	Delay time at surface "SA" stage before loop (s)	[0-86400 (24 hr)]
1	Delay time at surface "SA" stage in "pattern" loop (s)	[0-7200 (2 hr)]
2	Delay time at surface "SA" stage in "cycle" loop (s)	[0-7200 (2 hr)]
3	Delay time for test "TC" stage (s)	[0-7200 (2 hr)]

[END_OF_LIFE]

No.	Comment	Limitation
0	Enable/disable float recovery in end of life	-
1	Enable/disable GPS position acquisition at end of life	[True/False]
2	Transmission period at end of life (s)	[900-86400 (24 hr)]
3	List of alarms that can cause end of life (alarms 18 and 19 cannot be modified)	0;1;4;5;10;21;28 (18;19)

[SECURITY]

No.	Comment	Limitation
0	Management method for grounding detection during descent parking	[1-3]
1	Set point offset in case of grounding management by correction (dbar)	[50-150]
2	Detection management method for hanging during ascent	[0-2]
3	Minimum pressure for correction in case of grounding detection	[100-1000]
4	Management method for grounding detection during descent profile	[2-3]

[SURFACE_APPROACH]

No.	Comment	Limitation
0	Enable/disable near-surface deceleration	[True/False]
1	Depth for "slow" start of ascent (dbar)	[100-500]

[SURFACE_ACQUISITION]

No.	Comment	Limitation
0	Enable/disable surface acquisition	[True/False]
1	Acquisition duration (s)	[60-1800]

[ICE]

No.	Comment	Limitation
0	Enable/disable ice detection	[True/False]
1	Depth for "slow" start of ascent (dbar)	[100-500]
2	Depth for execution of ice detection test (dbar)	[10-100]
3	Duration of ice detection test	[0-900 (15 min)]

[CYCLE]

No.	Comment	Limitation
0	Enable/disable cycle periodicity	[True/False]
1	Specific "parking" drift depth (dbar)	[100-2000]
2	Cycle duration (s)	[86400 (1j)-2419200 (28 days)]

[IRIDIUM_RUDICS]

No.	Comment	Limitation
0	DNIS number associated with the SIM card	14 characters
1	Login of account associated with float (on the server)	15 characters
2	Password of account associated with float (on the server)	15 characters
3	Serial port number	1
4	Maximum duration of Iridium session (s)	[3600 (1 hr)-86400]
5	Block size for file segmentation	[5-40]
6	Measurement file format (*.csv, *.hex extended, *.hex standard)	[0-2]
7	File transmission mode (standard, extended, high speed)	[0-2]

[MOTOR]

No.	Comment	Limitation
0	Mechanics identification	HRL1, NKE1
1	Total oil volume in the hydraulic system (cm3)	[1500.0-3500.0]

[PAYLOAD]

No.	Comment	Limitation
0	Serial port number	30
1	Power output number	3
2	Enable/disable "$ADJUST" message	[True/False]
3	Enable/disable complete self-test	[True/False]

[EMAP_1]

No.	Comment	Limitation
0	Serial port number	30
1	Power output number	3
2	USEA's sensor list: 2 – DO 3 – OCR 4 – ECO 5 – SBEPH 6 – CROVER 7 – SUNA 8 – UVP6	2;3;4;5;7;8;

[GPS]

No.	Comment	Limitation
0	Serial port number	40
1	Power output number	4
2	Enable/disable PPS synchronisation (external module)	[True/False]
3	Enable/disable enhanced positioning (altitude 0m)	[True/False]

4	Enable/disable system clock synchronization	[True/False]

[SENSOR_XX]

Common settings for all sensors.

No.	Comment	Limitation
0	Enable/disable the sensor	[True/False]
1	Zone 1 - Sampling period / descent to drift depth (s)	[0-3600 (1 hr)]
2	Zone 1 - Sampling period / parking depth drift (s)	[0-86400 (24 hr)]
3	Zone 1 - Sampling period / descent to measurement depth (s)	[0-3600 (1 hr)]
4	Zone 1 - Sampling period / measurement depth drift (s)	[0-3600 (1 hr)]
5	Zone 1 - Sampling period / ascent (s)	[0-3600 (1 hr)]
6	Zone 1 – Acquisition type	[0-3]
7	Zone 1 – Processing type	b00000xxx
8	Zone 1 – Synchronisation type	b00000xxx
9	Zone 1 – Section depth	[1-500]
10	Zone 2 - Sampling period / descent to drift depth (s)	[0-3600 (1 hr)]
11	Zone 2 - Sampling period / parking depth drift (s)	[0-86400 (24 hr)]
12	Zone 2 - Sampling period / descent to measurement depth (s)	[0-3600 (1 hr)]
13	Zone 2 - Sampling period / measurement depth drift (s)	[0-3600 (1 hr)]
14	Zone 2 - Sampling period / ascent (s)	[0-3600 (1 hr)]
15	Zone 2 – Acquisition type	[0-3]
16	Zone 2 – Processing type	b00000xxx
17	Zone 2 – Synchronisation type	b00000xxx
18	Zone 2 – Section depth	[1-500]
19	Zone 3 - Sampling period / descent to drift depth (s)	[0-3600 (1 hr)]
20	Zone 3 - Sampling period / parking depth drift (s)	[0-86400 (24 hr)]
21	Zone 3 - Sampling period / descent to measurement depth (s)	[0-3600 (1 hr)]
22	Zone 3 - Sampling period / measurement depth drift (s)	[0-3600 (1 hr)]
23	Zone 3 - Sampling period / ascent (s)	[0-3600 (1 hr)]
24	Zone 3 – Acquisition type	[0-3]
25	Zone 3 – Processing type	b00000xxx
26	Zone 3 – Synchronisation type	b00000xxx
27	Zone 3 – Section depth	[1-500]
28	Zone 4 - Sampling period / descent to drift depth (s)	[0-3600 (1 hr)]
29	Zone 4 - Sampling period / parking depth drift (s)	[0-86400 (24 hr)]
30	Zone 4 - Sampling period / descent to measurement depth (s)	[0-3600 (1 hr)]
31	Zone 4 - Sampling period / measurement depth drift (s)	[0-3600 (1 hr)]
32	Zone 4 - Sampling period / ascent (s)	[0-3600 (1 hr)]
33	Zone 4 – Acquisition type	[0-3]
34	Zone 4 – Processing type	b00000xxx
35	Zone 4 – Synchronisation type	b00000xxx
36	Zone 4 – Section depth	[1-500]
37	Zone 5 - Sampling period / descent to drift depth (s)	[0-3600 (1 hr)]
38	Zone 5 - Sampling period / parking depth drift (s)	[0-86400 (24 hr)]
39	Zone 5 - Sampling period / descent to measurement depth (s)	[0-3600 (1 hr)]
40	Zone 5 - Sampling period / measurement depth drift (s)	[0-3600 (1 hr)]
41	Zone 5 - Sampling period / ascent (s)	[0-3600 (1 hr)]
42	Zone 5 – Acquisition type	[0-3]
43	Zone 5 – Processing type	b00000xxx

44	Zone 5 – Synchronisation type	b00000xxx
45	Zone 5 – Section depth	[1-500]
46	Pressure threshold between zones 1 and 2	[1-2100]
47	Pressure threshold between zones 2 and 3	[2-2100]
48	Pressure threshold between zones 3 and 4	[5-2100]
49	Pressure threshold between zones 4 and 5	[10-2100]
50	Sensor warm-up time (ms)	[0-60000]
51	Sensor shut down time (ms)	[0-60000]
52	Filtering index of first valid sample	[1-25]
53	Number of samples per section in "Eco" acquisition mode	[1-100]
60	Surface - Sampling period / in-air measurements (s)	[0-600 (10 min)]

[SENSOR_01]

Parameter setting specific to SBE41 sensor.

No.	Comment	Limitation
54	"Cut-off" pressure (dbar)	[1-10]
55	Enable/disable fast sampling period (1 Hz)	[True/False]

[SENSOR_08]

Parameter setting specific to UVP6 sensor.

No.	Comment	Limitation
54	Zone 1 - Configuration file	ACQ_NKE_XXXXX
55	Zone 2 - Configuration file	ACQ_NKE_XXXXX
56	Zone 3 - Configuration file	ACQ_NKE_XXXXX
57	Zone 4 - Configuration file	ACQ_NKE_XXXXX
58	Zone 5 - Configuration file	ACQ_NKE_XXXXX
59	Parking depth drift - Configuration file	ACQ_NKE_XXXXX
61	Parking depth drift – Image count for average	[1-100]
62	Parking depth drift – Sampling period (s)	[2-15]

[SDA14]

N°	Comments	Limitation
0	Internal communication port	30
1	Internal power supply output	3
2	Internal awake signal output	5
3	Pressure threshold for acoustic measurement 1 (dbar)	[10.0-2000.0]
4	Pressure threshold for acoustic measurement 2 (dbar)	[10.0-2000.0]
5	Pressure threshold for acoustic measurement 3 (dbar)	[10.0-2000.0]
6	Pressure threshold for acoustic measurement 4 (dbar)	[10.0-2000.0]
7	Pressure threshold for acoustic measurement 5 (dbar)	[10.0-2000.0]
8	Pressure threshold for acoustic measurement 6 (dbar)	[10.0-2000.0]
9	Pressure threshold for acoustic measurement 7 (dbar)	[10.0-2000.0]
10	Pressure threshold for acoustic measurement 8 (dbar)	[10.0-2000.0]
11	Pressure threshold for acoustic measurement 9 (dbar)	[10.0-2000.0]
12	Pressure threshold for acoustic measurement 10 (dbar)	[10.0-2000.0]
13	Pressure tolerance for acoustic measurement (dbar)	[5.0-50.0]
14	Speed stability threshold for valid acoustic measurement (cm/s)	[1.0-10.0]

[SPECIAL]

N°	Comments	Limitation
0	Enable/disable sub-surface duration optimization	[True/False]
1	Enable/disable sub-surface brake action	[True/False]

[PRESSURE_ACTIVATION]

No.	Comment	Limitation
0	Enable/disable the pressure activation	[True/False]
1	Pressure threshold for mission activation (dbar)	[5-30]
2	Maximum duration of the pressure test (s)	[0-7776000 (90 days)]

3. Definition of the mission

The mission is described as a script, which is executed sequentially. Scripts can be interleaved with one another (up to 2 levels of interleaving).

3.1 List of elementary stages

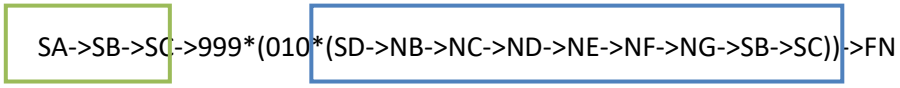
Various so-called "elementary" stages are used to describe the course of the mission. Some manage navigation, others actions at the surface, etc.

Symbol	Comment
Navigation	
NA (*)	Emergence reduction
NB	Descent to "parking" drift depth
NC	Drift at "parking" depth
ND	Descent to "measurement" depth
NE	Drift at "measurement" depth
NF	Ascent to surface
NG	Awaiting the end of ascent
NH (*)	Emergence
NI	Survival ascent
NJ	Ascent to deceleration depth
NK	Ascent to ice detection test depth
NL	Resuming ascent to surface
Surface	
SA	Temporization
SB	GPS position acquisition and UTC synchronisation
SC	Transmission session
SD	Sequence management stage (pattern)
SE	Sequence management stage (cycle)
SF	Surface acquisition stage
Test	
TB	Ice detection test
TC	External test (passive standby)
TD	Pressure activation test (launch test)
Other	
FN	End of life

(*) Stages automatically handled by the script manager. Do not use.

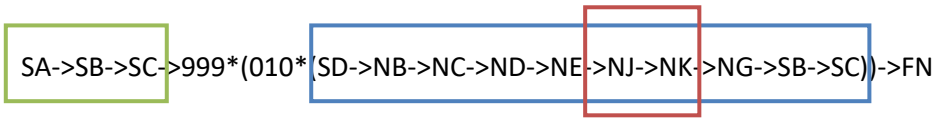
3.2 "Standard" mission

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Standard patterns (max. 10) and unlimited number of cycles



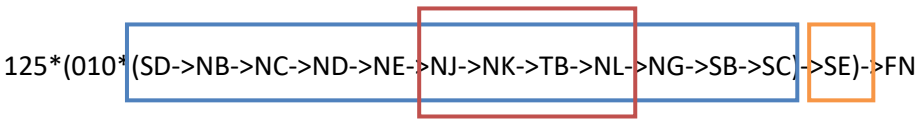
3.3 "Near-surface deceleration" mission

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Patterns with deceleration during ascent



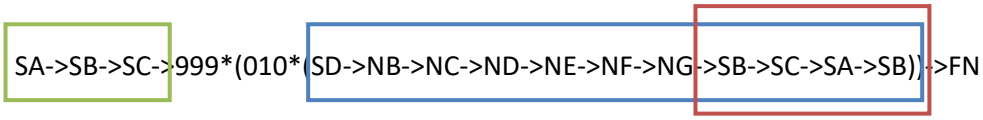
3.4 External "Ice detection" mission

- Float deployed while sinking, with no initial phase at surface
- Patterns with deceleration during ascent and standby for external ice detection test
- Cycle periodicity management stage
- Limited number of cycles



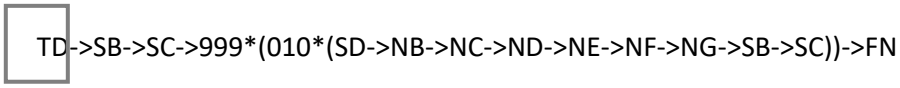
3.5 "Dual GPS session – drift monitoring" mission

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Dual GPS sessions spaced by a time interval



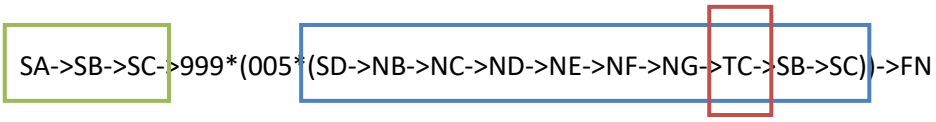
3.6 "Pressure activation" mission

- Pressure activation test for mission activation (float MUST be in heavy condition)



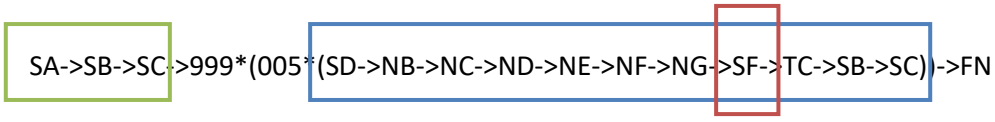
3.7 "Standard" mission (with USEA board)

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Standard patterns (max. 5) and unlimited number of cycles
- External test – waiting for the end of USEA data treatment



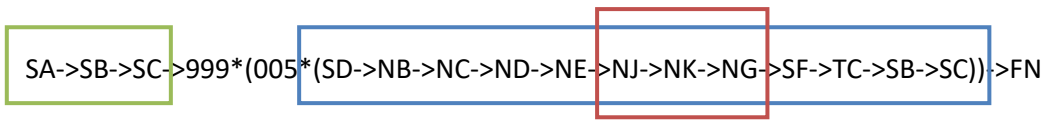
3.8 "Surface acquisition" mission (with USEA board)

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Standard patterns (max. 5) and unlimited number of cycles
- Surface acquisition
- External test – waiting for the end of USEA data treatment



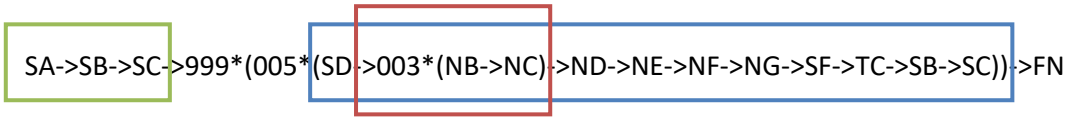
3.9 "Ice avoidance" mission (with USEA board)

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Standard patterns (max. 5) and unlimited number of cycles
- Patterns with deceleration during ascent
- Surface acquisition
- External test – waiting for the end of USEA data treatment



3.10 "Multi-Parking" mission (with USEA board)

- Initial phase at surface (passive standby then GPS position acquisition and transmission)
- Multi-parking (max. 3) patterns (max. 5) and unlimited number of cycles
- Surface acquisition
- External test – waiting for the end of USEA data treatment



4. Float installation

4.1.Ballasting

The float can be deployed with the bladder either empty or full. If the self-ballasting parameter (SYSTEM.P9) is enabled, the float automatically inflates its bladder before the mission. In that case, the float is in "floating" deployment. Otherwise, it uses the "sinking" type.

4.2.Self-test

Before the mission starts, the float performs a system self-test. It is possible to choose between a quick version and a full version depending on the requirements of the deployment.

The differences concern the testing of devices:

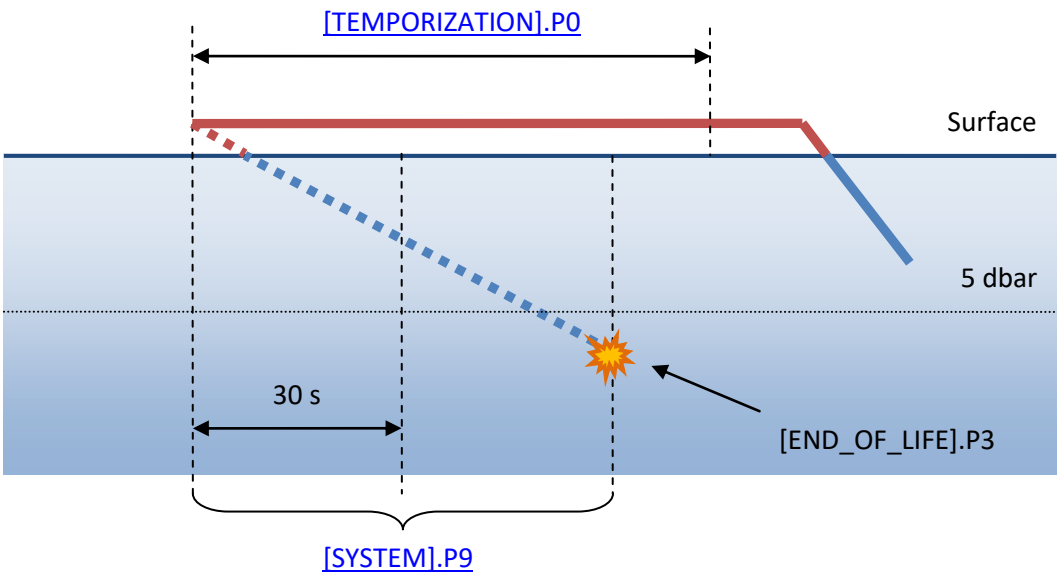
- GPS: quick test of GPS response / complete with position acquisition
- Modem: quick test of modem response / complete with satellite connection

4.3."Floating" deployment of float

4.3.1. "Heavy" float detection

When the float is deployed in "floating" mode, the initial temporization stage can be used to perform a buoyancy check of the float and to detect potential ballasting problems. This is particularly useful if a session at the surface is carried out upon deployment (GPS position acquisition and/or transmission) in order to guarantee the integrity of the float.

Detection consists in monitoring the pressure every 30 seconds and detecting if the pressure threshold is exceeded. If that is the case, a "heavy float" alarm is generated.

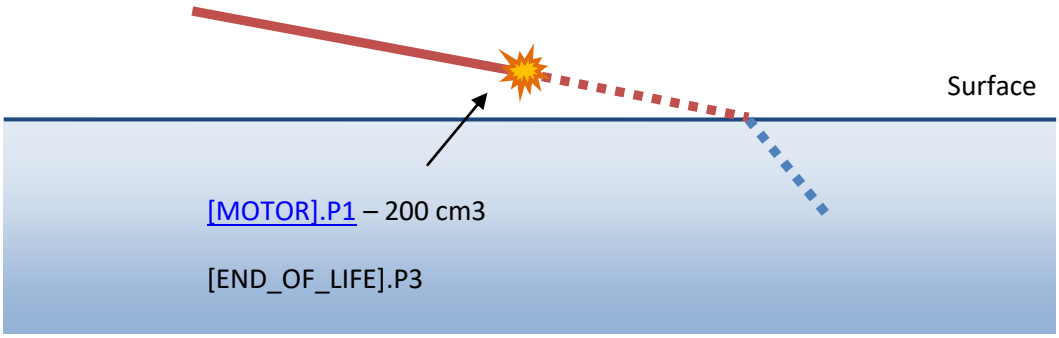


If this alarm has been reported in the list of events that lead to the end of life, the float performs a "survival" ascent.

4.3.2. "Light" float detection

When the float initiates its emergence reduction, a safety task checks that the float has enough oil in reserve to perform its navigation.

If there are less than 200 cm3 left to carry out the descent and the float is still at the surface, a "light float" alarm is generated.



If this alarm has been reported in the list of events that lead to the end of life, the float performs a "survival" ascent.

4.4."Sinking" deployment of float

For certain types of deployments (e.g. "ice" type), it may be useful to deploy the float as readily "sinking". In that case, programming a script that begins with a session at the surface should be avoided.

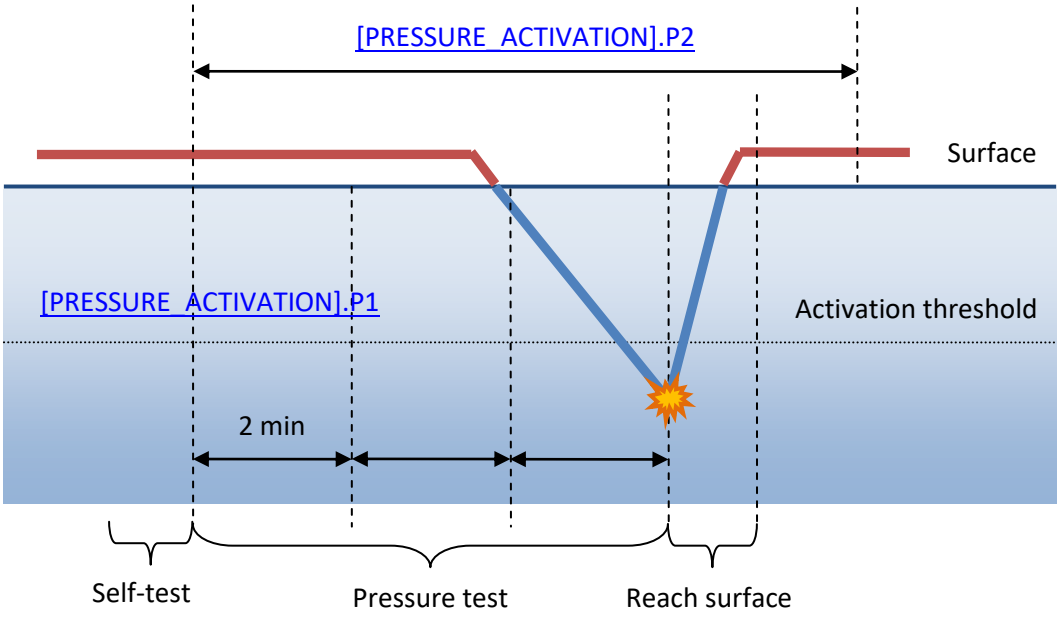
Deploying a float in “sinking” condition can results in chock on sea bed or exceeds the pressure limit and damage the float. User must take care the float is well ballasted in order to insure the float is not too heavy.

4.4.1. "Pressure activation" deployment

With a specific mission script, the float is able to be delivered to a ship ready to deploy without any specialized operator intervention.

In order for pressure activation to work the float must be in “sinking” condition. It must be able to sink from the surface down to the pressure activation threshold when deployed.

The pressure activation starts with a successful self-test. The float enters a pressure test phase during which it monitors the pressure every two minutes. When the pressure exceeds the activation threshold, the float increases its buoyancy to reach the surface and starts the mission.

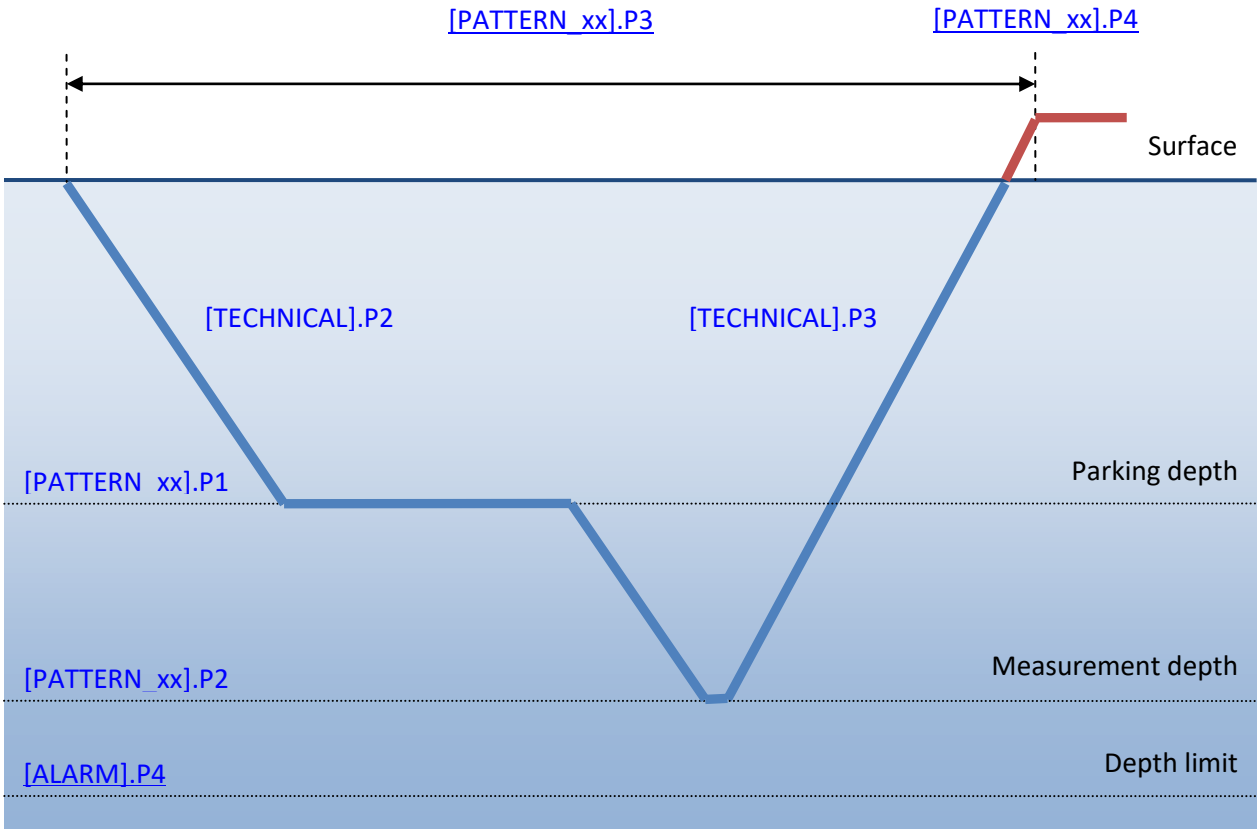


In case the pressure test phase fails, the float will engage the mission after a maximum duration.

When the mission starts (end of pressure test succeed or fails) the pressure activation parameter [PRESSURE_ACTIVATION].P0 is deactivated automatically.

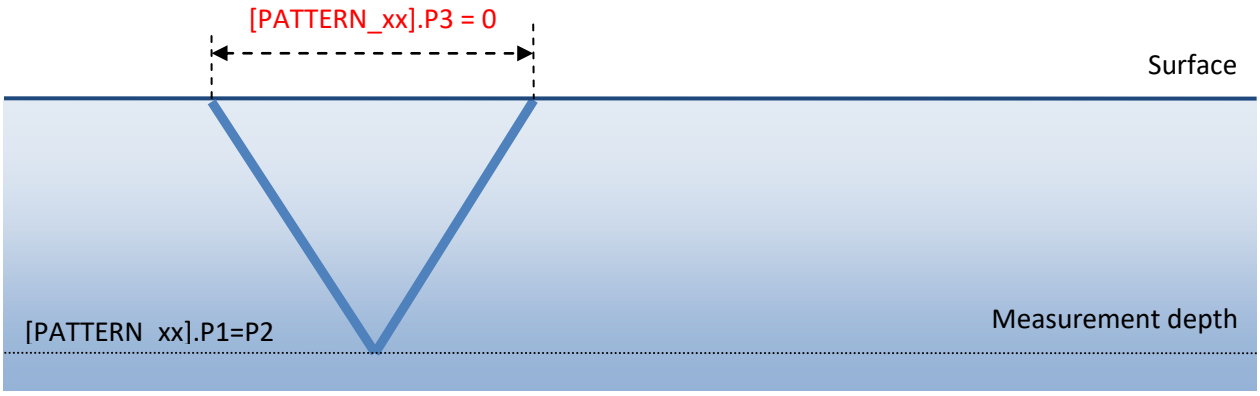
5. Setting a pattern

- A pattern is defined as the execution of a profile followed by an optional session at the surface (GPS, transmission...)
- Without surface synchronisation, the setting for the profile duration [PATTERN].P3 corresponds to the set point of the profile duration
- In case of surface synchronisation, the setting for the profile duration [PATTERN].P3 corresponds to the minimum value of the profile duration



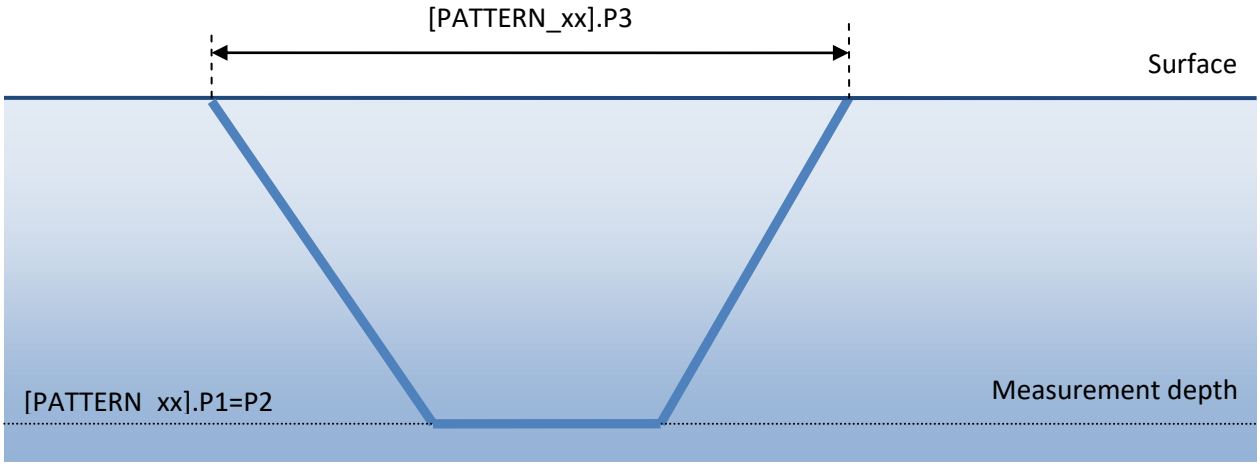
5.1. Case 1: maintaining the measurement depth

The profile is performed in order to observe the measurement depth.



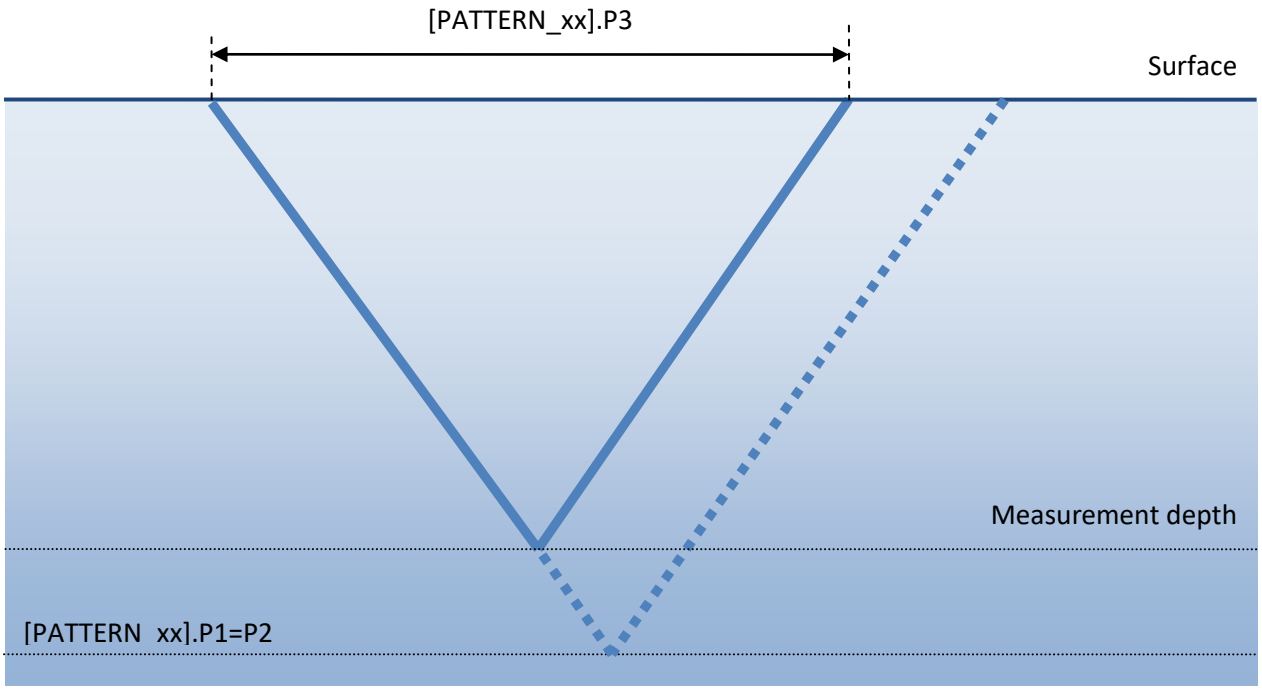
5.2.Case 2: maintaining the profile duration (depth reached)

The profile is performed with standby at parking depth in order to observe the profile duration.



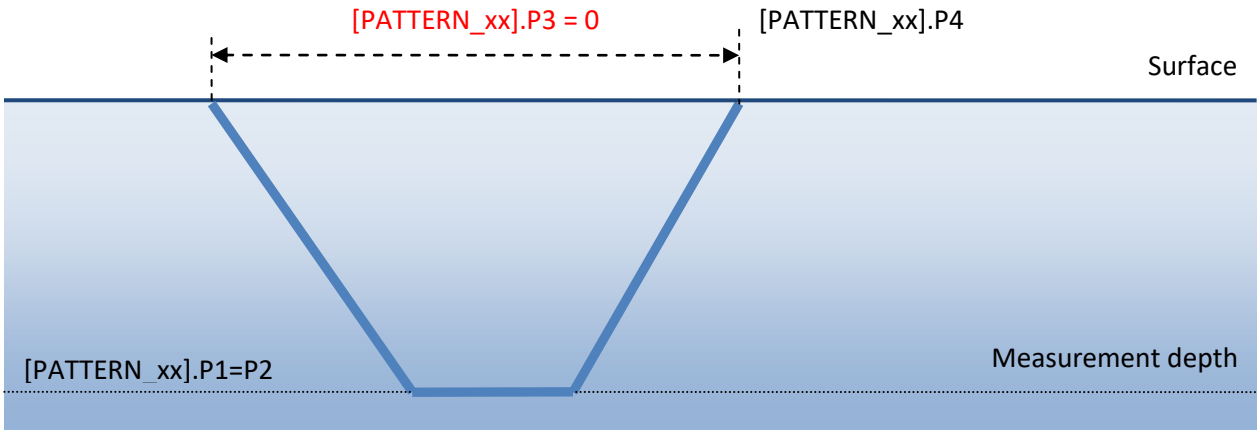
5.3.Case 3: maintaining the profile duration (depth not reached)

If the profile cannot be performed within the time allocated, the ascent is anticipated in order to observe the profile duration.

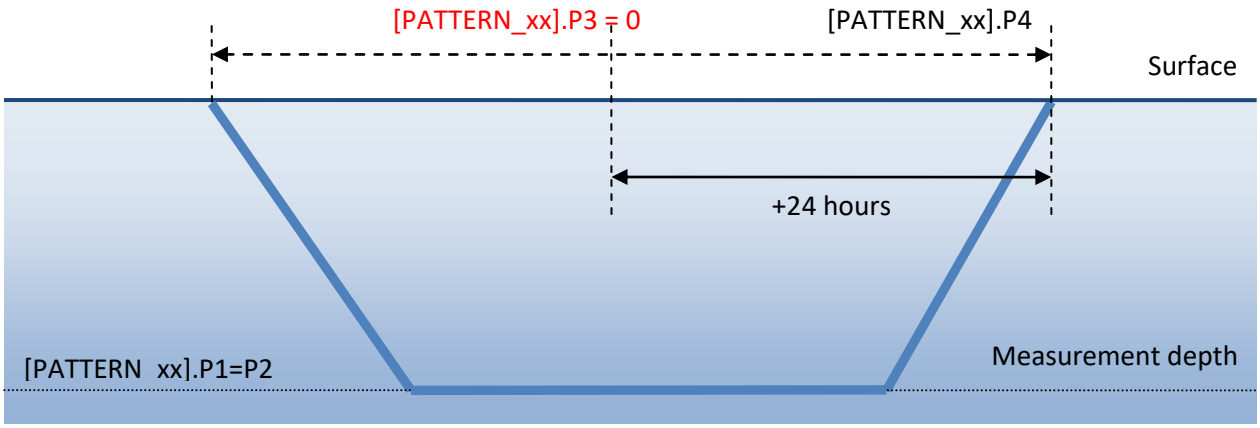


5.4.Case 4: maintaining measurement depth and surface synchronization

The profile is performed with standby at parking depth in order to observe the time of presence at the surface and the measurement depth.

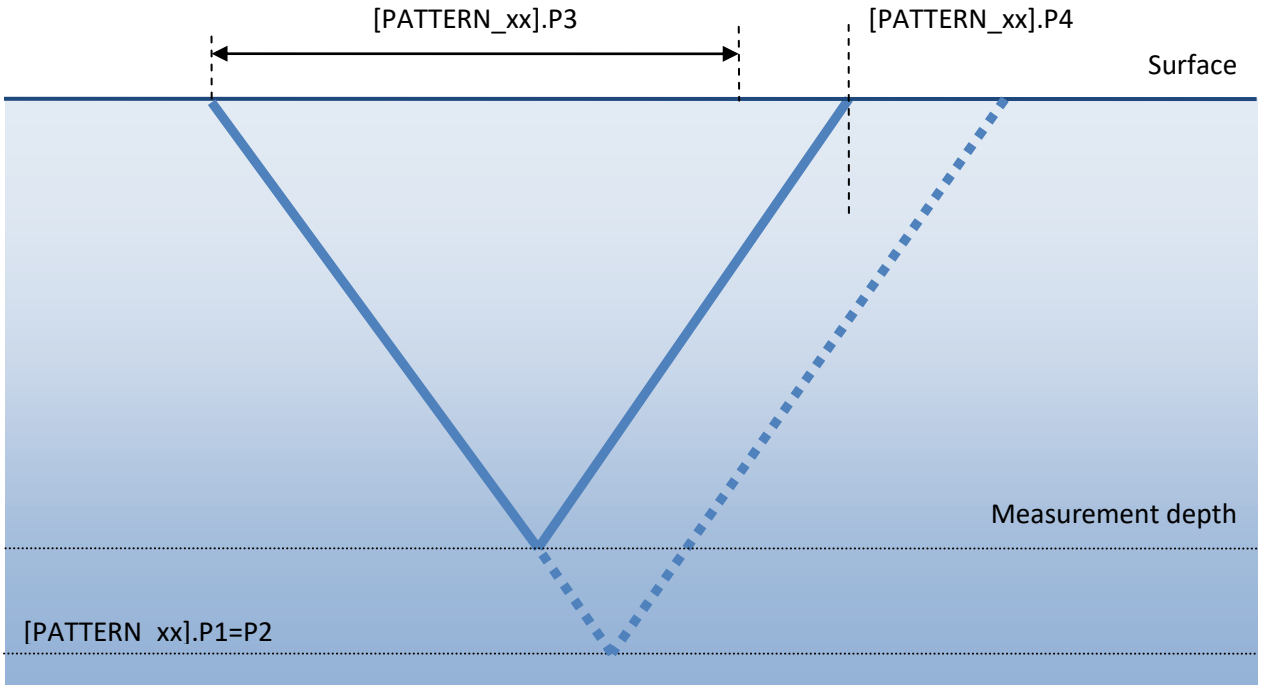


If the profile cannot be performed while observing the time of presence at the surface and the measurement depth, the time of presence at the surface is postponed to the following day.



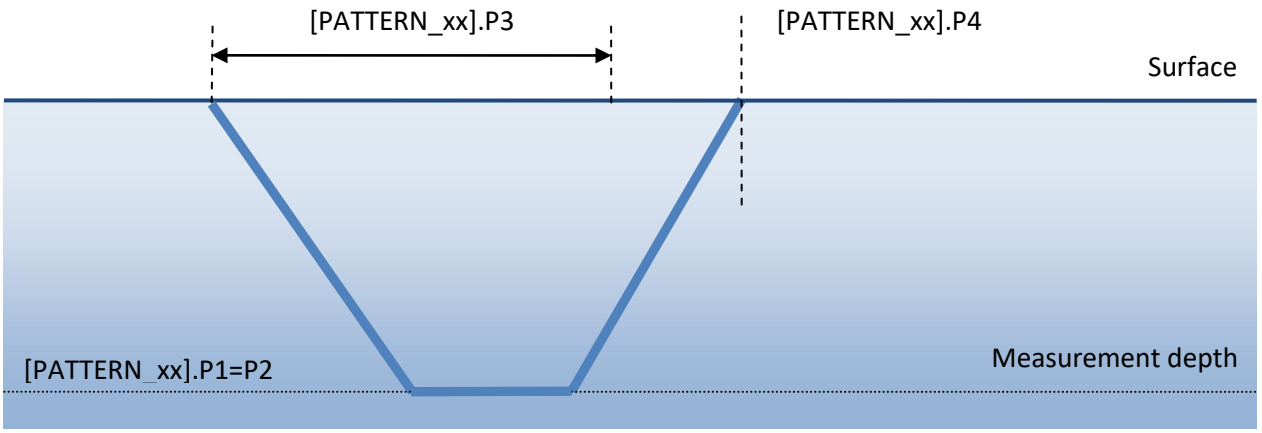
5.5.Case 5: maintaining surface synchronization (depth not reached)

If the profile cannot be performed within the time allocated, the ascent is anticipated in order to observe the time of presence at the surface.

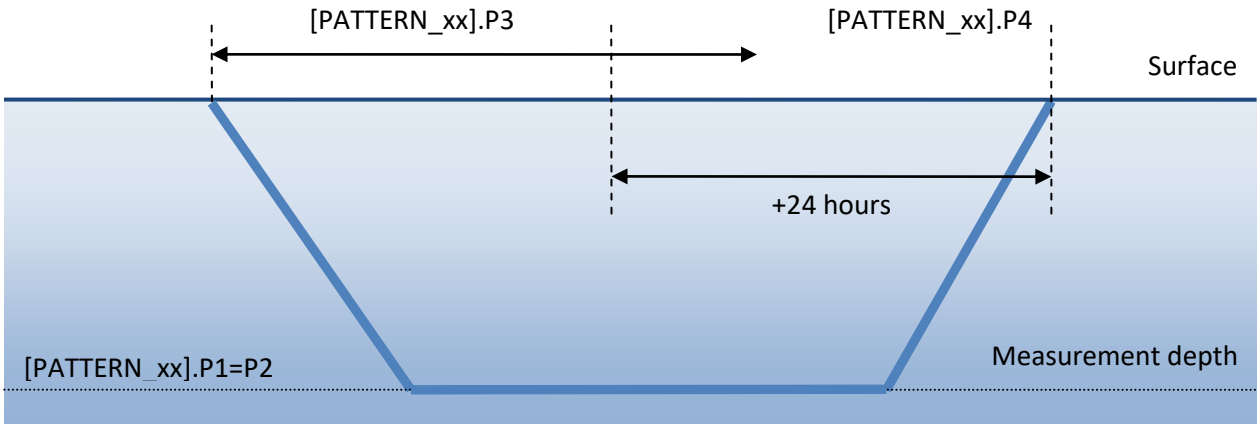


5.6.Case 6: maintaining surface synchronisation (depth reached)

The profile is performed with standby at parking depth in order to observe the time of presence at the surface and the minimum duration.



If the profile cannot be performed while observing the time of presence at the surface and the minimum duration, the time of presence at the surface is postponed to the following day.



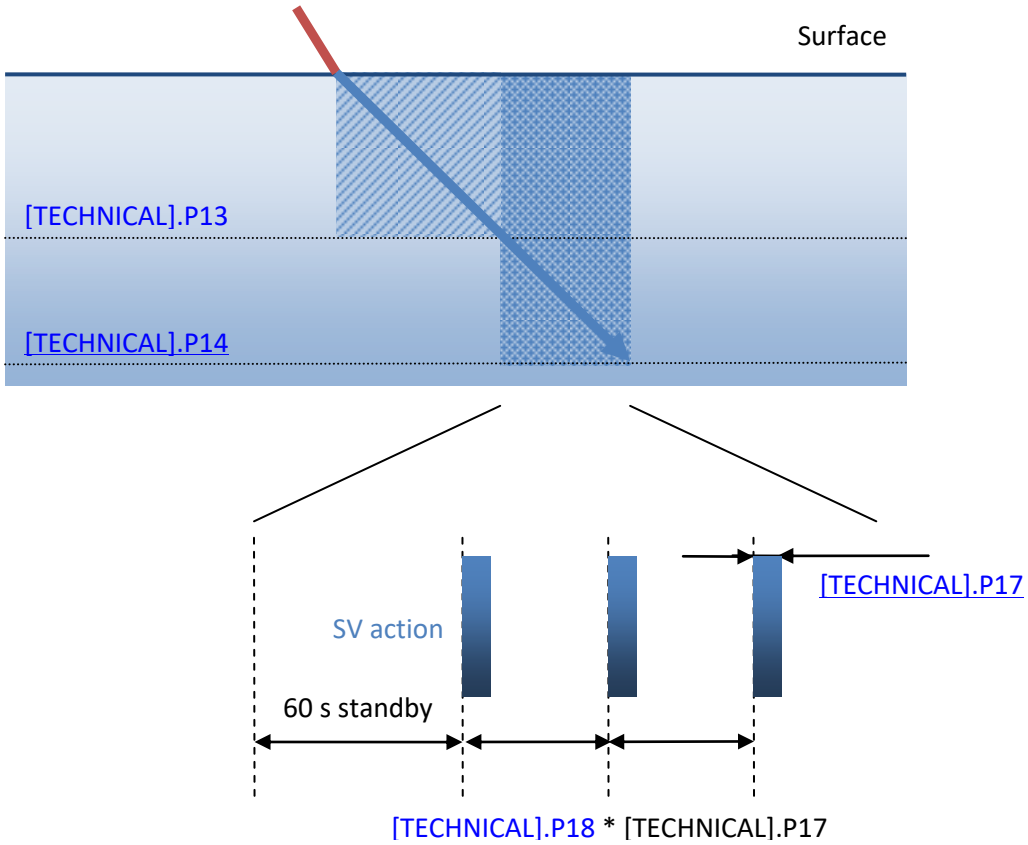
6. Surface management

6.1.Emergence reduction

The emergence reduction consists in decreasing the buoyancy of the float following a session at the surface, until sinking is detected.

The operation is as follows:

- Emergence reduction in two stages:
  - "Quick" phase up to threshold 1 (permanent SV opening)
  - "Standard" phase up to threshold 2 (modulated SV opening)
- During both phases, pressure monitoring is active (active CTD mode). If the threshold is exceeded, the SV is closed immediately.
- The modulation of SV opening in the "standard" phase consists in performing SV actions (variable duration) spaced from one another (the shorter and more spaced SV actions are, the more precise the detection of sinking will be). This modulation is implemented 60 seconds after the phase change.



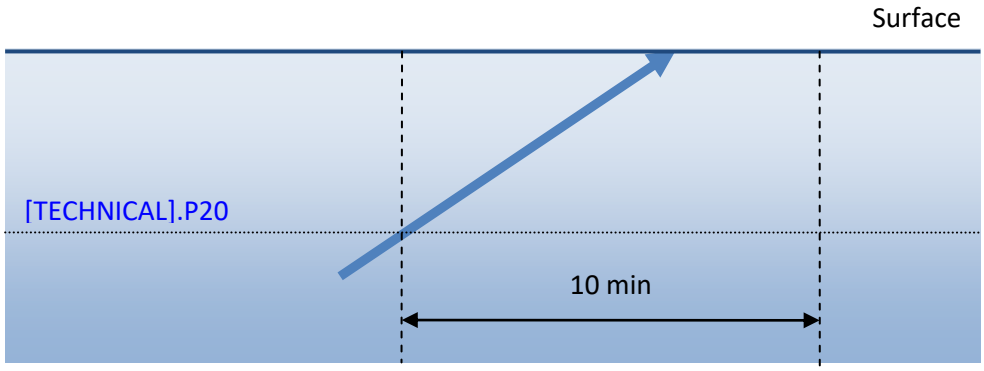
Before initiating the emergence reduction, the system performs the external pressure offset. This stage may be conditioned by the success of at least one of the surface actions.

6.2.Awaiting the end of ascent

Awaiting the end of ascent consists in allowing the ascending float to continue its course for 10 minutes following the detection of the approaching surface.

During this waiting period:

- No hydraulic action takes place
- Sensors are still in acquisition mode

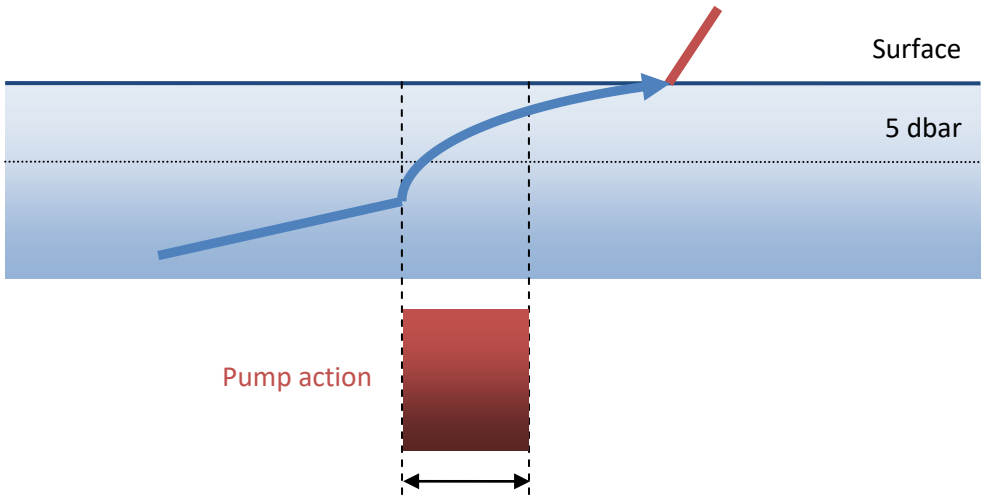


6.3.Emergence

The emergence consists in providing sufficient buoyancy to the float to perform a session at the surface.

The operation is as follows:

- A fixed pump action takes place during the time spent at the surface
- A second identical action takes place if the pressure is greater than 5 dbar at the end of the first fixed action



[TECHNICAL].P19

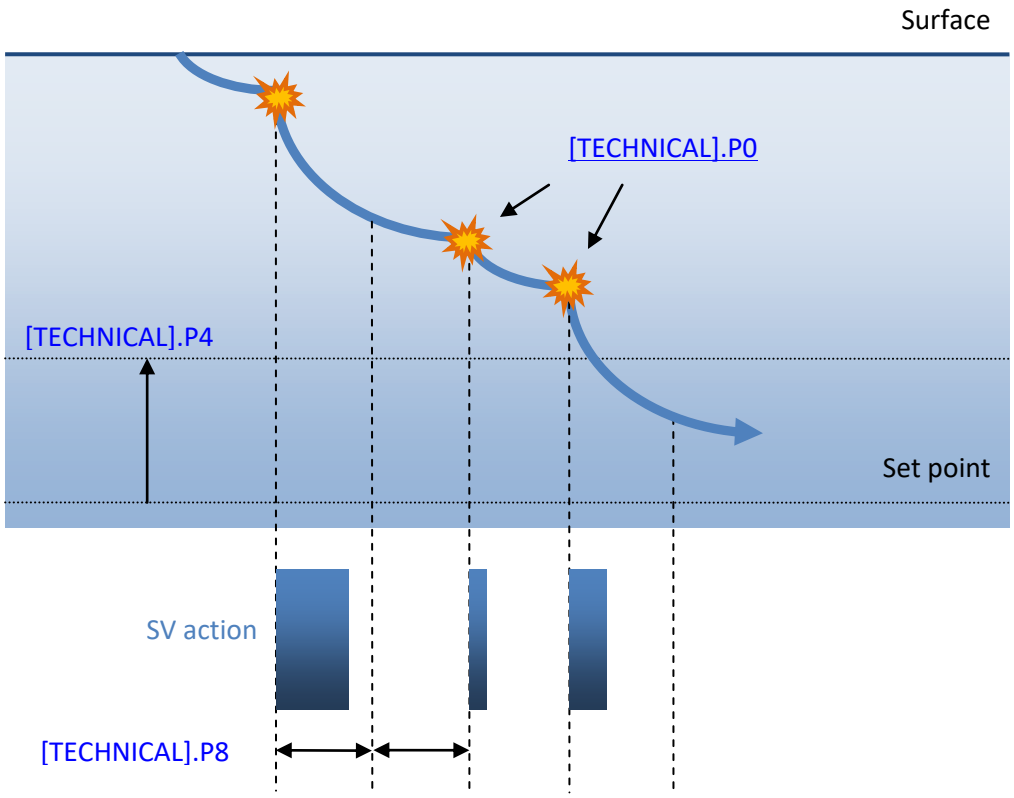
7. Navigation

7.1.Descent

The descent consists in reaching a set depth while controlling the navigation speed of the float.

The operation is as follows:

- Rate of descent monitoring at fixed time intervals
- SV actions modulated over time
- End of descent when approaching the set point

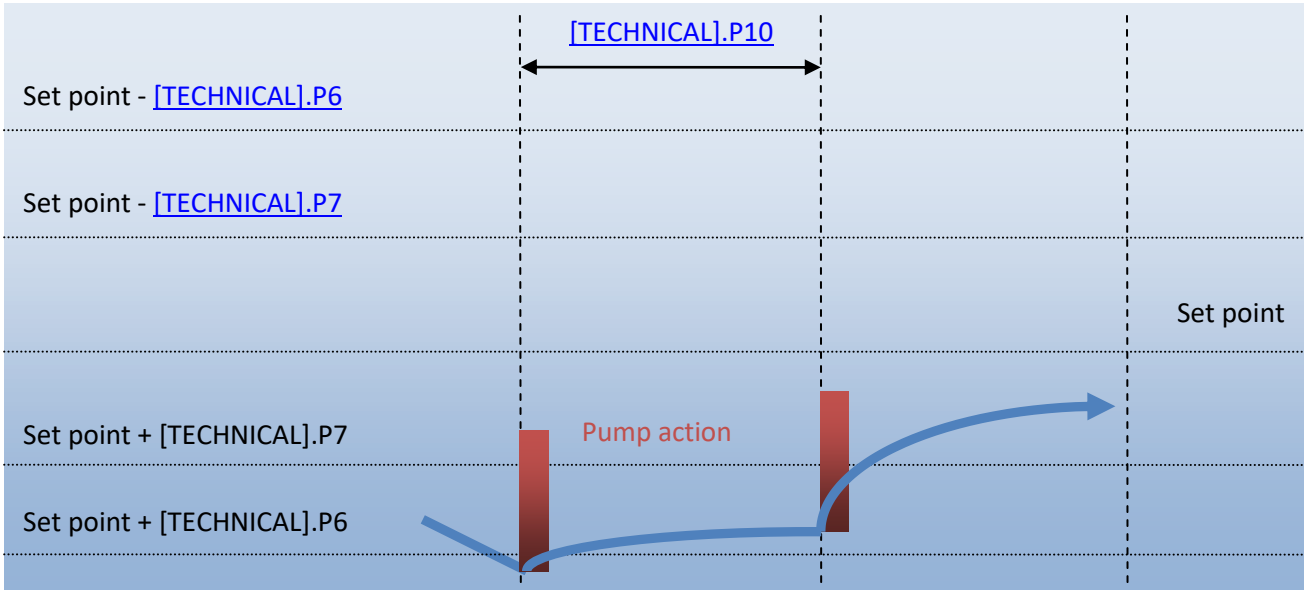


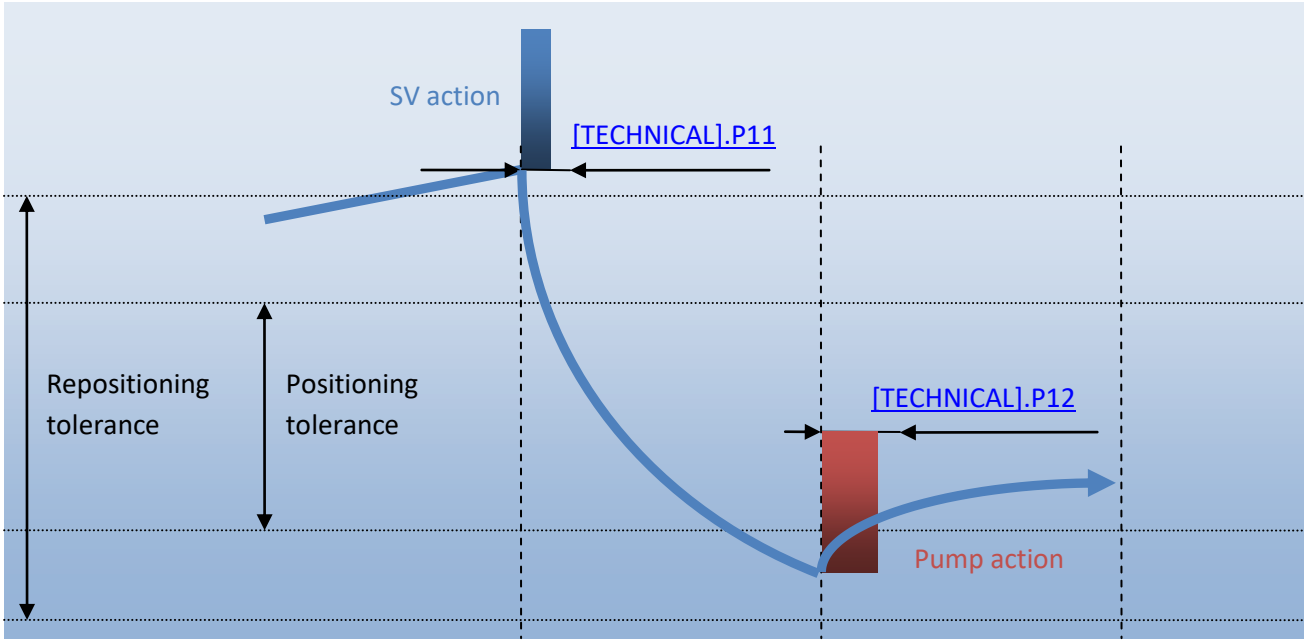
7.2.Repositioning during drift

Repositioning during drift consists in maintaining the float around a set depth.

The operation is as follows:

- Pressure monitoring at fixed time intervals
- Repositioning if the current pressure deviates from the set point by more than the repositioning tolerance
- Repositioning completed when the current position is deviated from the set point by less than the positioning tolerance


[TECHNICAL].P10
Set point - [TECHNICAL].P6
Set point - [TECHNICAL].P7
Set point
Set point + [TECHNICAL].P7
Pump action
Set point + [TECHNICAL].P6

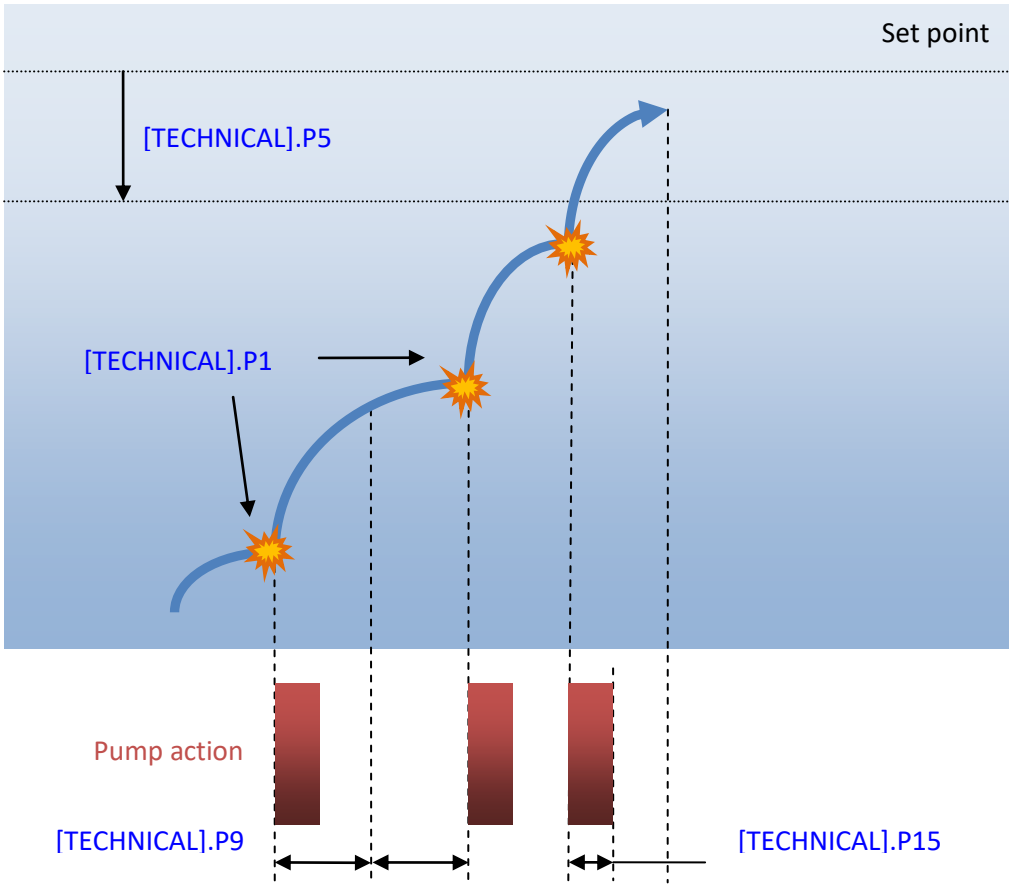

SV action
[TECHNICAL].P11
Repositioning tolerance
Positioning tolerance
[TECHNICAL].P12
Pump action

7.3.Ascent

The ascent consists in reaching a set depth while controlling the navigation speed of the float.

The operation is as follows:

- Rate of ascent monitoring at fixed time intervals
- Fixed pump actions
- End of ascent when approaching the set point



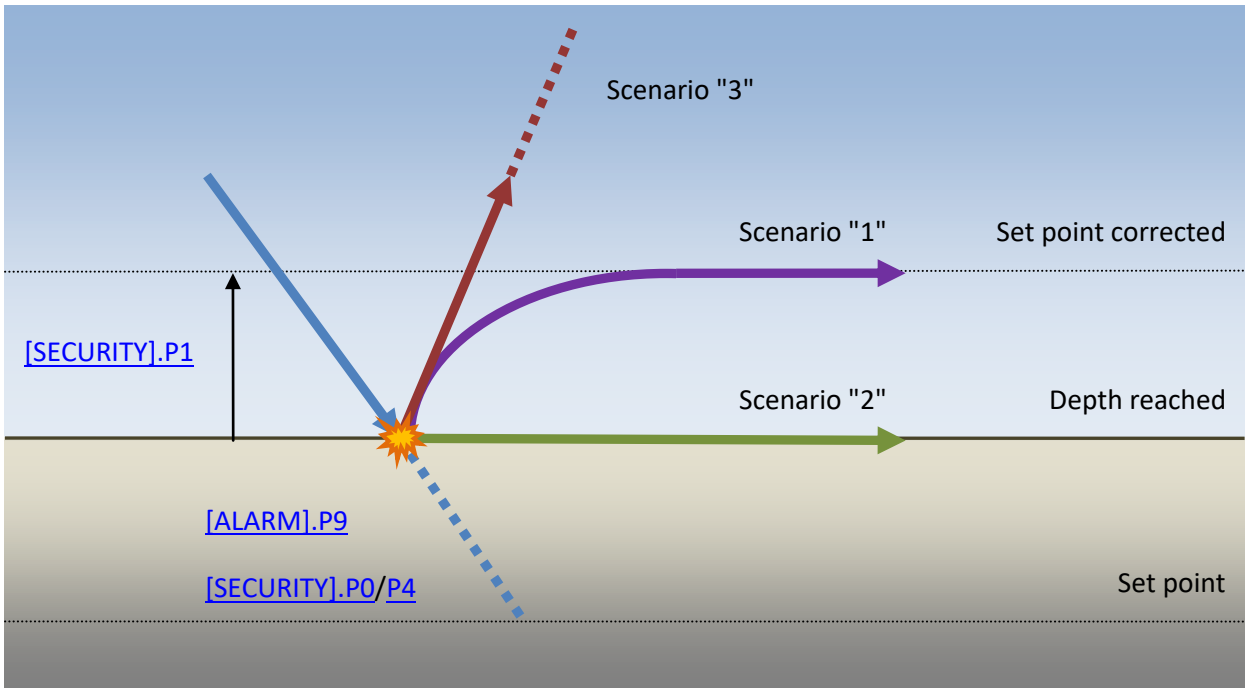
8. Management of degraded modes

8.1.Grounding

The grounding during the descent consists in detecting the absence of movement of the float despite a large displacement of oil to descend.

The operation is as follows:

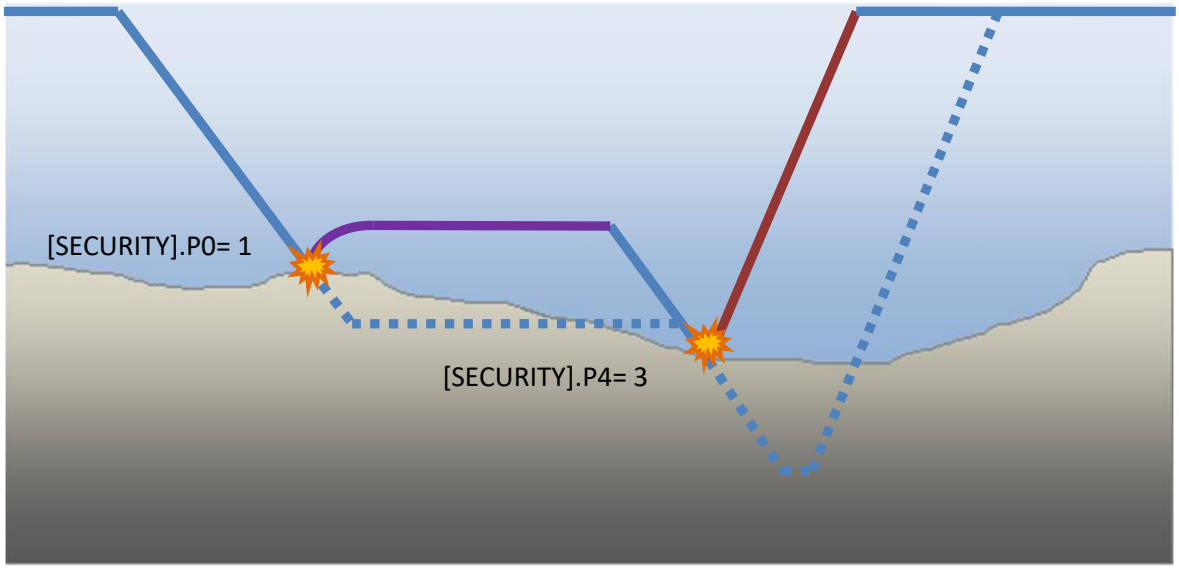
- A safety task monitors the travel speed of the float and detects stabilisations less than 1 cm/s
- When stabilisation is detected, the cumulative volume of oil is compared with a threshold
- Upon detection of grounding:
    - **Scenario "1": Escape mode - Set point correction**
      The pre-programmed drift depth is disregarded. The pressure at the time of grounding minus an offset ([SECURITY].P1) is taken as the new value for the drift pressure. The float adjusts its buoyancy to reach this new dript depth. The drift depth stays unchanged for the subsequent cycles. If the grounding pressure is lower than the programmed threshold ([SECURITY].P3), the float remains on the seabed until the ascent time.
    - **Scenario "2": Static mode – Stay on seabed**
      The float remains where it is until the ascent time. The pressure at the time of grounding becomes the ascent profile start pressure for the current cycle. The ascent profile start pressure stays unchanged for the subsequent cycles.
    - **Scenario "3": Early surface mode – Ascent immediately**
      The float starts to ascent immediately to reach the surface.



The strategy to adopt in case of grounding is configured for descent to parking depth and parking drift stages by [SECURITY].P0.
The strategy to adopt in case of grounding is configured for descent to profile depth and profile depth drift stages by [SECURITY].P4.

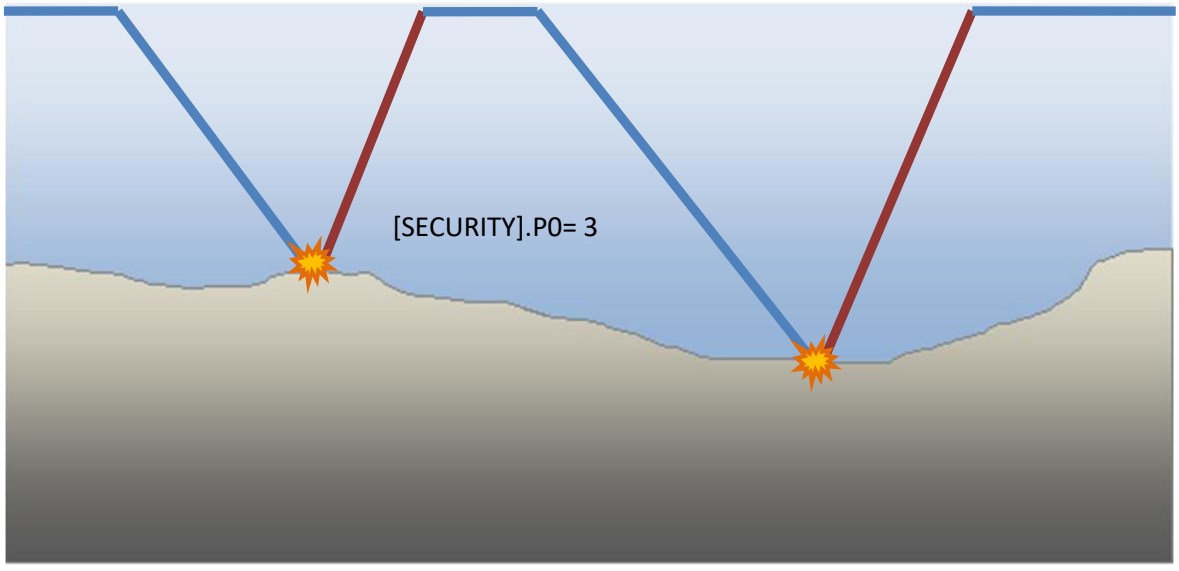
8.1.1. Case 1: “standard” management

In this configuration, the profiler corrects its parking depth in order to continue to dive during parking drift stage.



8.1.2. Case 2: “seabed touch and go” management

In this configuration, the profiler stops the descent stage and start the ascent stage when encountering the ground.

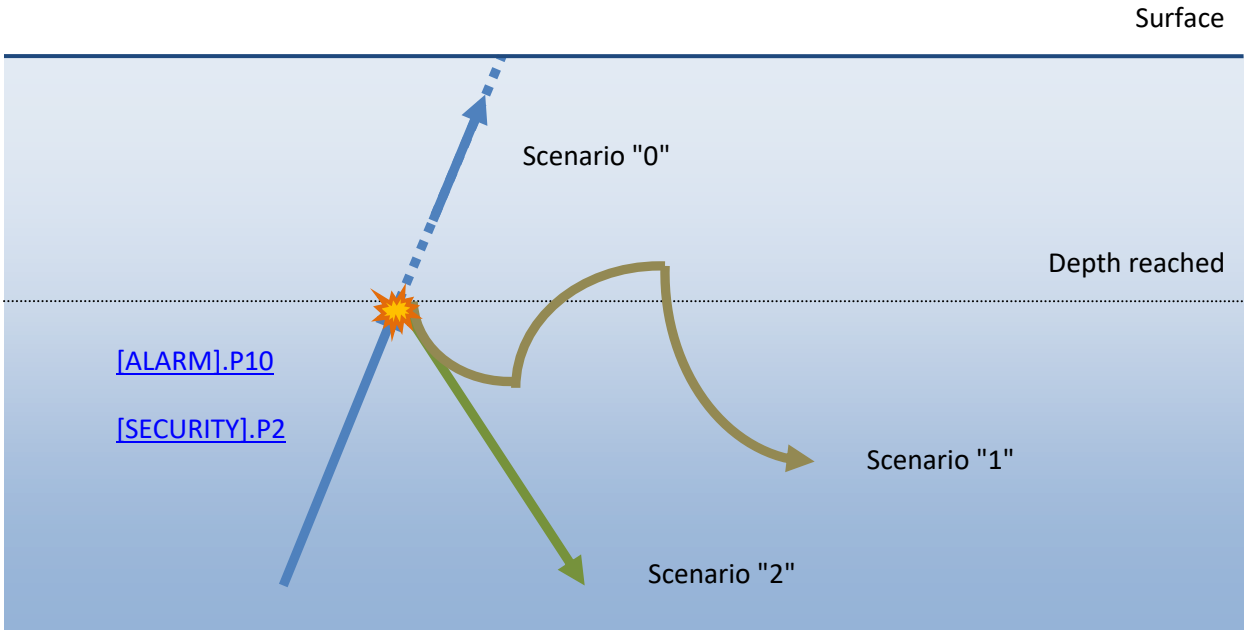


8.2.Hanging

The hanging during the ascent consists in detecting the absence of movement of the float despite a large displacement of oil to ascend.

The operation is as follows:

- A safety task monitors the travel speed of the float and detects stabilisations less than 1 cm/s
- When stabilisation is detected, the cumulative volume of oil is compared with a threshold
- Upon detection of hanging during ascent:
    - **Scenario "0": No detection**
    - **Scenario "1": 3-stage unblocking attempt**
      It consists in a succession of pump and SV bursts to free the float.
      If the float is freed, the ascent is resumed. If the operation fails, switch to survival ascent.
    - **Scenario "2": Abort pattern**
      Navigation continues without performing any emergence.



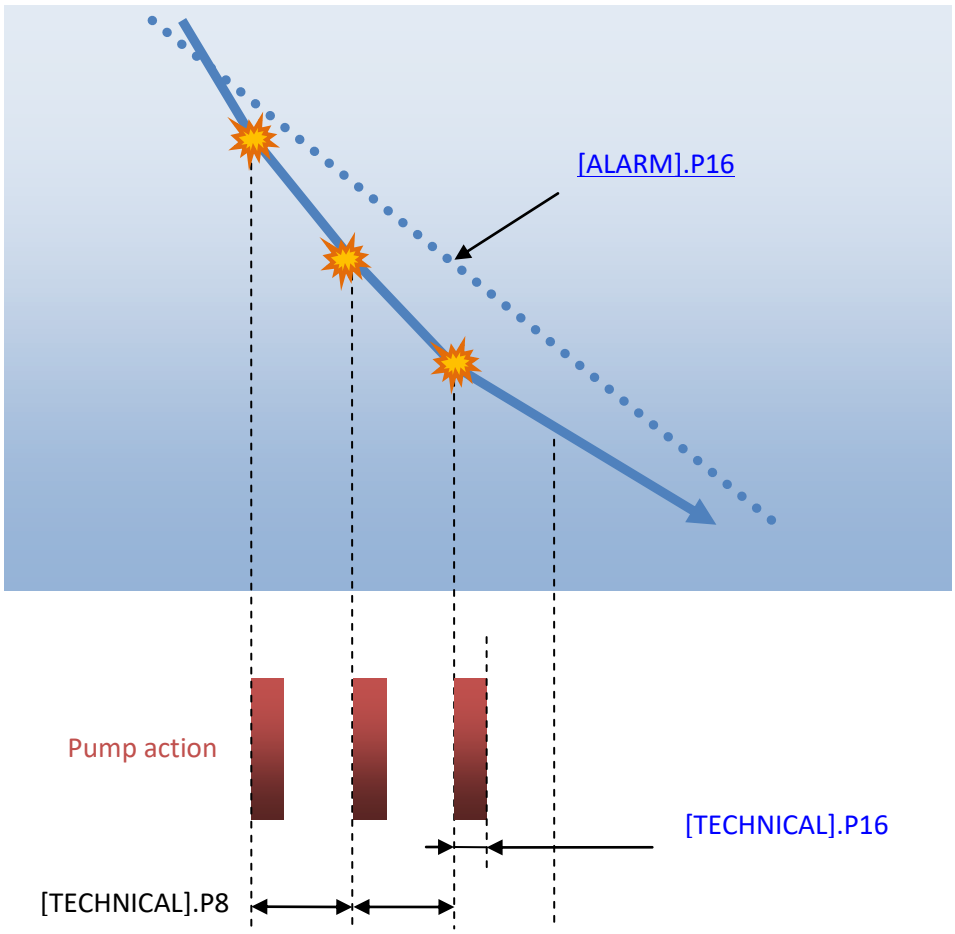
Note: When the "0" scenario is configured, the float will abort the ascent after 48 hours.

8.3.Braking during descent

Braking during descent consists in performing pump actions to slow down the sinking of the float if the speed limit is exceeded.

The operation is as follows:

- A safety task monitors the travel speed of the float and detects high speeds
- In case of abnormal speed, a fixed pump action takes place



8.4."Survival" ascent

The "survival" ascent consists in bringing the float back to the surface to acquire a GPS position and perform an immediate transmission. Then, the end of life mode is applied.

This ascent is called "survival" because it implies that a critical event occurred while the float was in navigation mode. The float is then placed in maximum buoyancy state in order to reach the surface as quickly as possible.

The events that will trigger this procedure can be chosen from a list.

The (optional) alarms that can trigger this procedure are as follows:

- High internal pressure
- High external pressure
- External pressure no longer responding
- Low battery voltage
- Low battery voltage (min. during pumping)
- Detection of water inside the float

The (non modifiable) alarms that can trigger this procedure are as follows:

- "Heavy/light" float

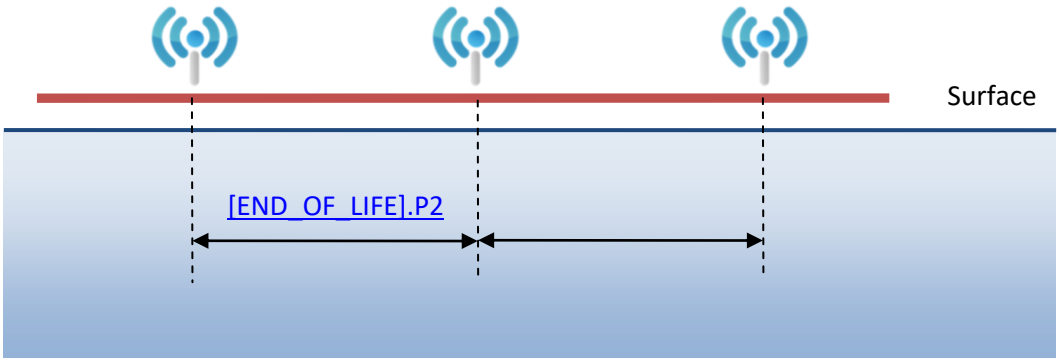
9. End of life

End of life can occur due to:

- At the end of the programmed maximum number of cycles
- In case of serious technical issue (user selectable event)
- Forced by remote control

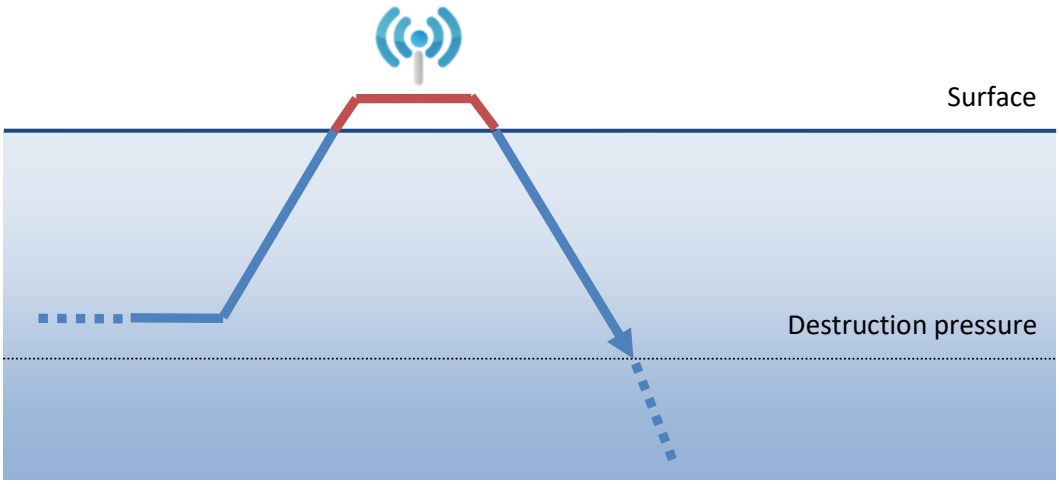
9.1. "Recovery" mode

The "recovery" mode consists in performing GPS position acquisitions (optional) and transmissions at regular intervals. In this phase, the float stays on surface. This mode is intended to facilitate recovery of the float from the ocean.



9.2. "Scuttling" mode

The "scuttling" mode consists in destroying the float at the end of the mission. After the last data transmission completion, the content of the internal memory is cleared and the float uses hydraulic SV action until destruction.



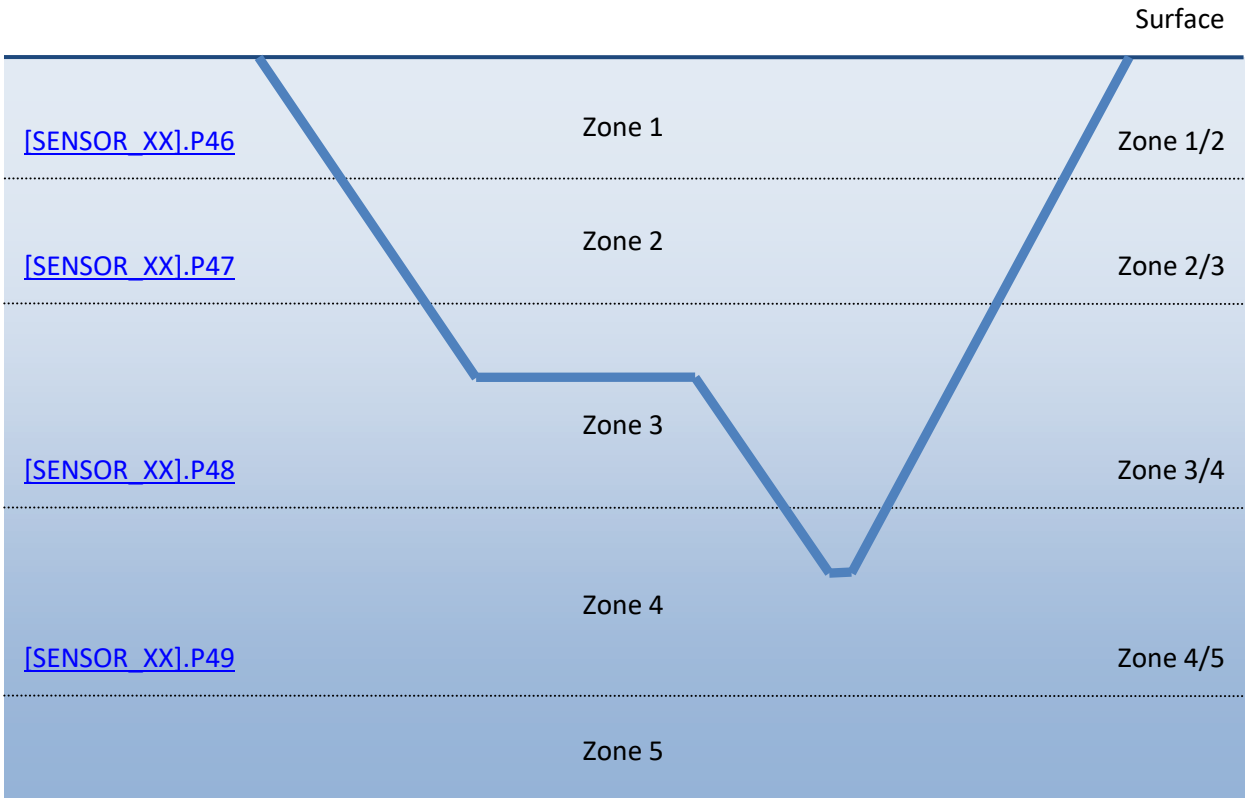
10. Standard sensors

Measurements of standard parameters can be done during descent, drift, ascent and surface phases.
Each sensor is managed independently:

- Status (enabled/disabled)
- Zone separation
- Acquisition rate (per zone and per phase)
- Control type (per zone)
- Synchronisation type (per zone)
- Processing type (per zone)
- Section depth (per zone)
- Specific parameters

10.1. Concept of zone

The water column can be divided into 5 different depth intervals in order to adapt the management of sensors to the experiment. Each depth interval (zone 1 to 5) is managed independently.



10.2. Power supply control

The type of power supply control for each sensor is managed independently according to the zone [SENSOR_XX].P6:

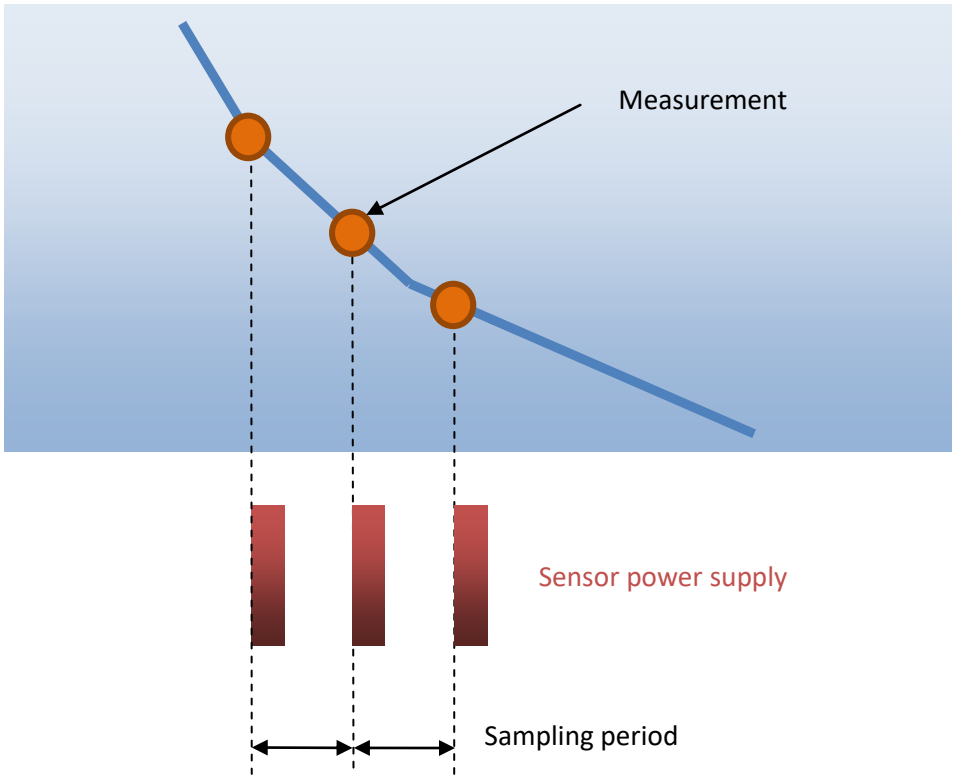
- None (0)
- Pulsed (2)
- Continuous (3)

10.2.1. None (0)

In "none" mode, there is no power supply control. The sensor is switched off in the zone.

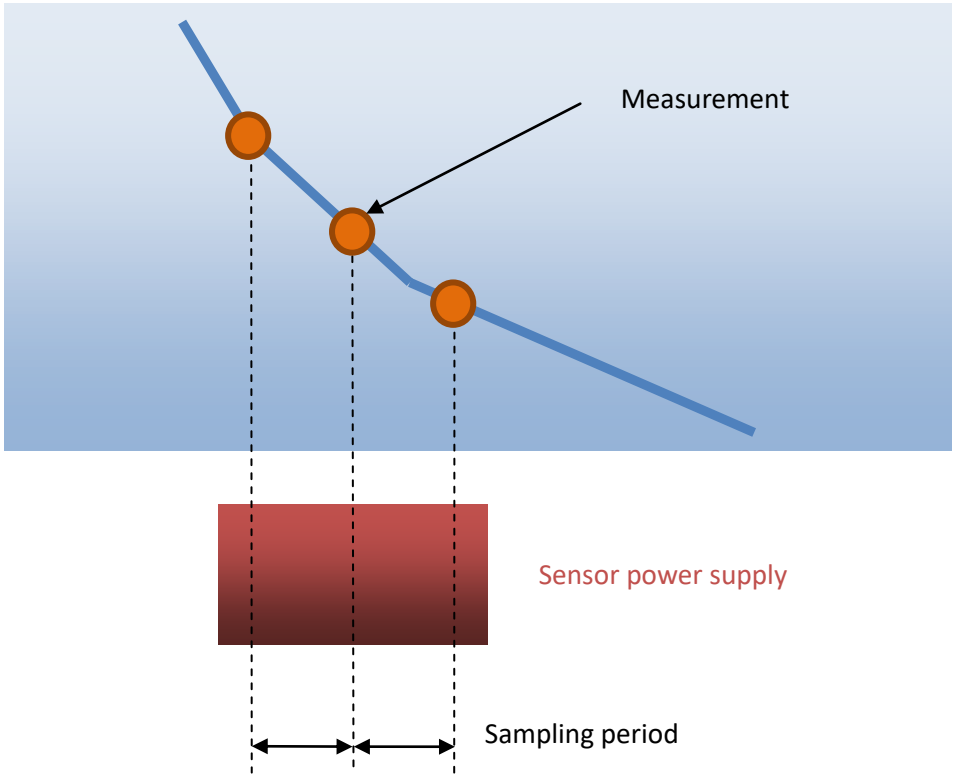
10.2.2. Pulsed (2)

In "pulsed" mode, the sensor is powered at regular intervals according to the acquisition rate. The sensor is switched off after the measurement.



10.2.3. Continuous (3)

In "continuous" mode, the sensor is powered continuously.

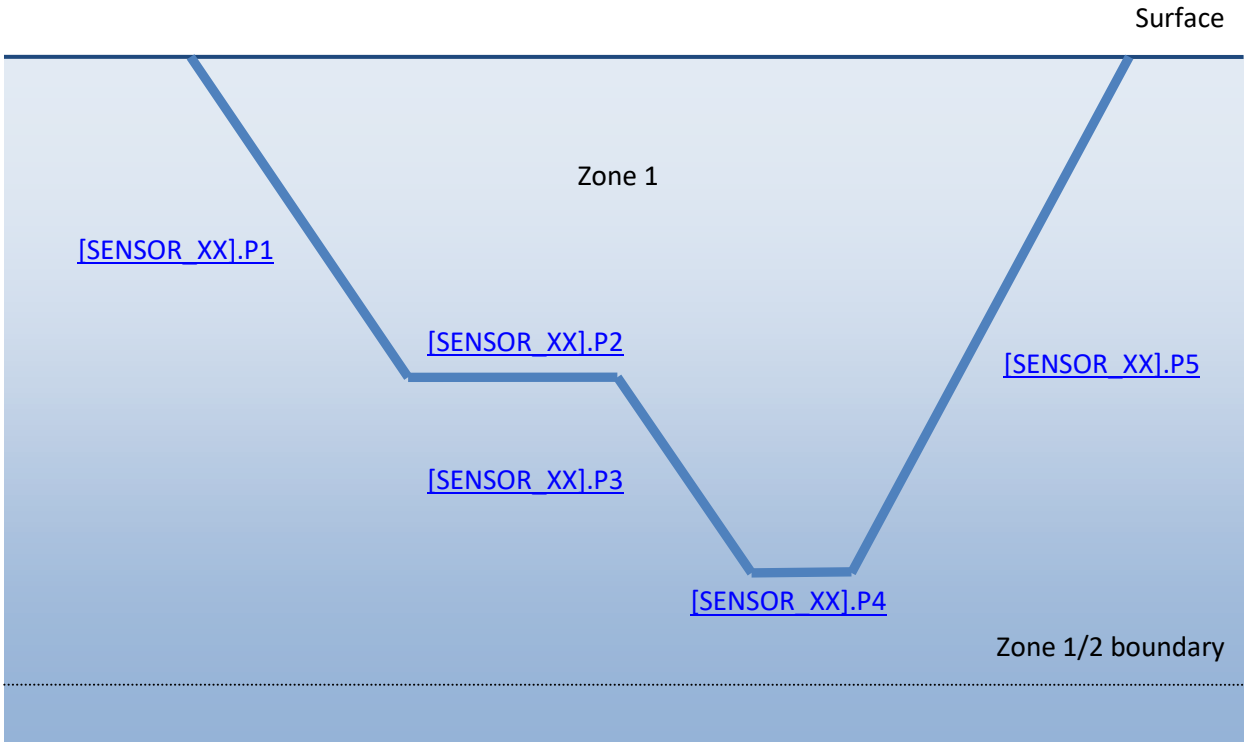


10.3. Acquisition rate

The acquisition rates of each sensor are managed independently according to the navigation phase:

- Descent to "parking" drift depth
- Drift at "parking" depth
- Descent to "measurement" depth
- Drift at "measurement" depth
- Ascent to surface
- Surface for “in air measurement”

It is possible to disable the acquisition in the phase by setting the rate at "0" seconds.



Note: Parameters not applicable if the "Eco" control mode is selected.

10.4. Data synchronisation

The measurements of each sensor can be synchronised according to the CTD data (from the main navigation sensor) [SENSOR_XX].P8:

- None (0x00)
- Pressure (0x01)
- Temperature (0x02)
- Salinity (0x04)

In this case, the quantity or quantities of the CTD sample temporally the closest are associated with the quantities measured by the sensor.

10.5. Data processing

The data of each sensor can be processed independently according to the zone [SENSOR_XX].P7:

- Raw (0x00)
- Decimated (0x08)
- Arithmetic mean (0x01)
- Median (0x02)
- Standard deviation (0x04)

Note: Some restrictions on data processing are implemented on the float:

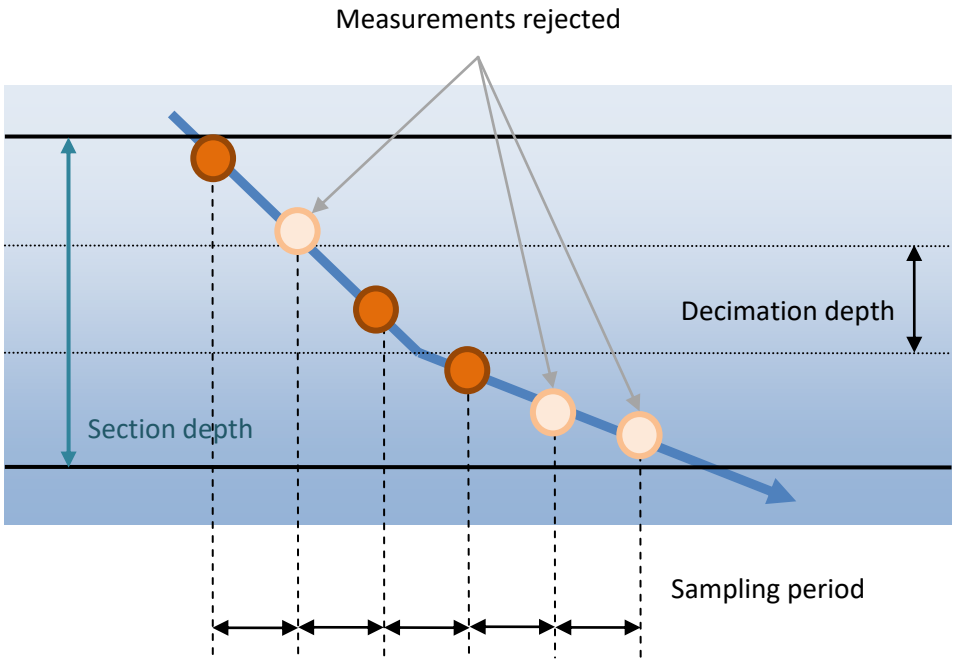
- During descent and ascent stages all data processing are available
- During drift stages data processing is fixed to raw processing
- During surface stage data processing is fixed to raw processing
- Median and Standard deviation processing are only available in combination with Arithmetic mean processing.

10.5.1. Decimation of measurements

When a type of processing is configured, the various points acquired can be decimated (according to pressure) so as not to influence the processing (in case the points are badly distributed over the water column).

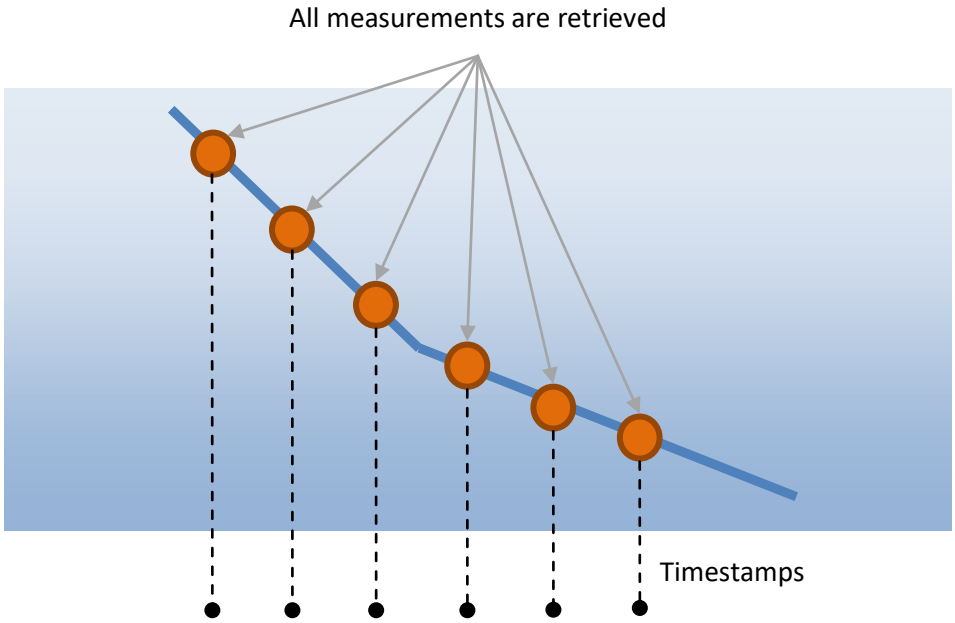
Decimation consists in keeping a single point per decimation depth. Decimation depth is selected automatically by the system according to the section depth [SENSOR_XX].P9:

- Depth of 0.1 dbar for sections of 1 dbar and less
- Depth of 0.2 dbar for sections between 1 and 5 dbar
- Depth of 0.5 dbar for sections of 5 dbar or more



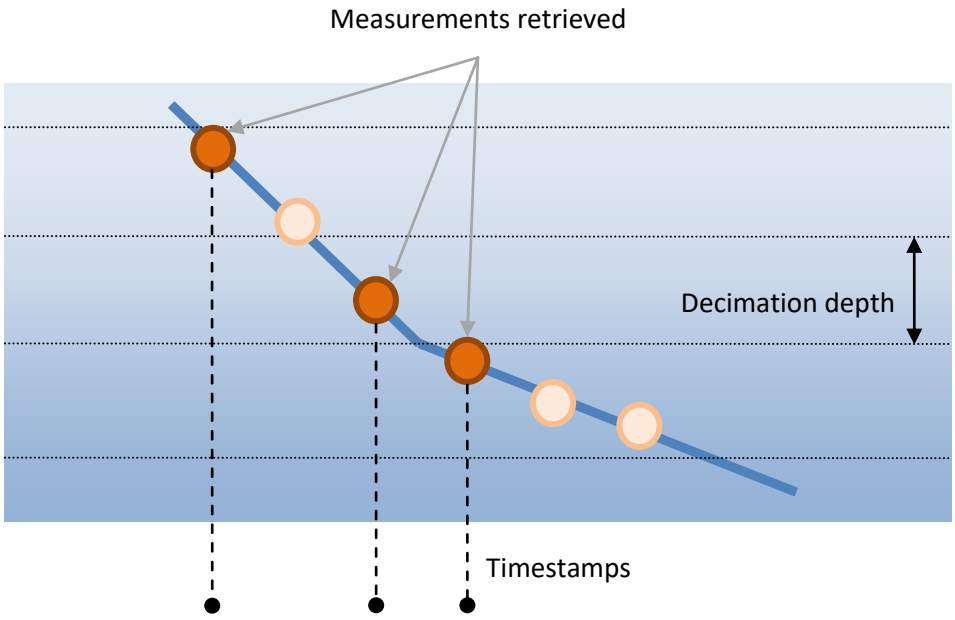
10.5.2. Raw (0x00)

In "raw" mode, the acquired data are retrieved without decimation.



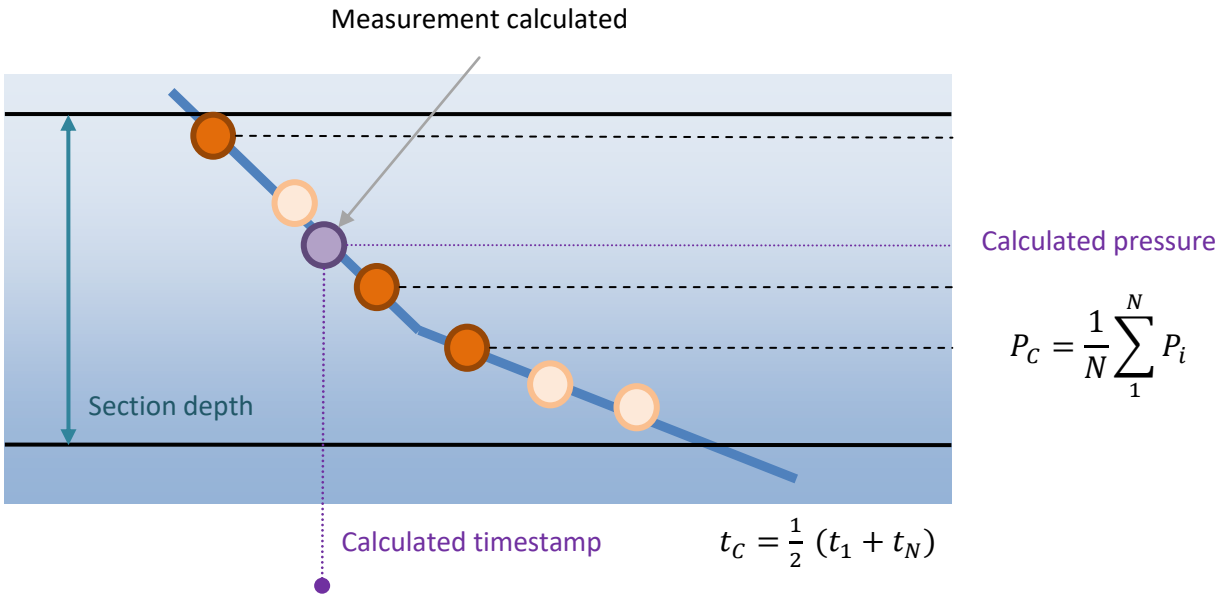
10.5.3. Decimated (0x08)

In “decimated” mode, the acquired data are decimated according to the section depth. In this case, decimation depth is equal to section depth.
The lowest section depth is 0.1 dbar.



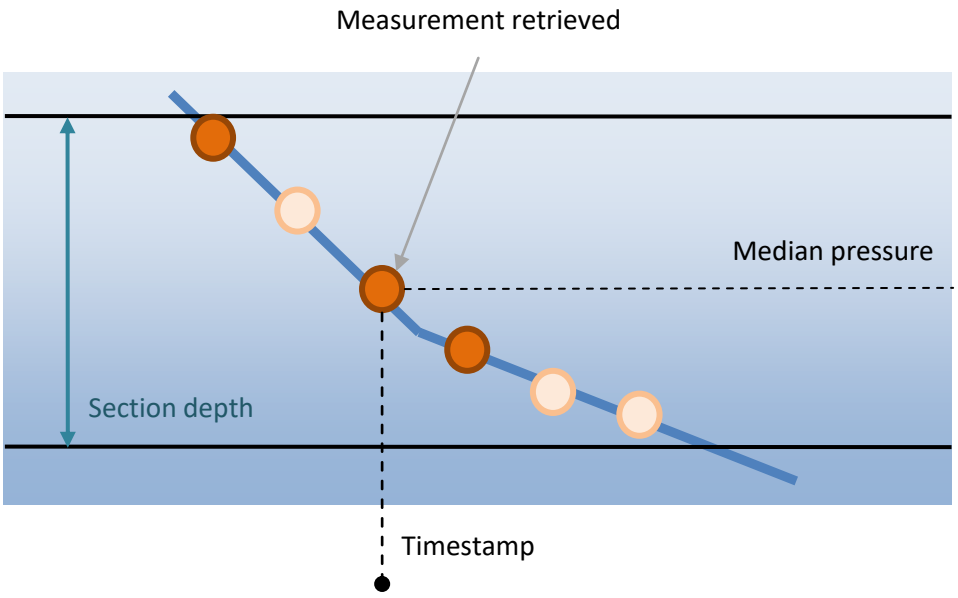
10.5.4. Arithmetic mean (0x01)

In "average" mode, the decimated data for the section are averaged and the calculated measurement is time-stamped. The lowest section depth is 0.5 dbar.



10.5.5. Median (0x02)

In "median" mode, data at the median pressure of the section are retrieved.



Note: The values retrieved are those associated with the median pressure, and not the medians from the various channels of the sensor.

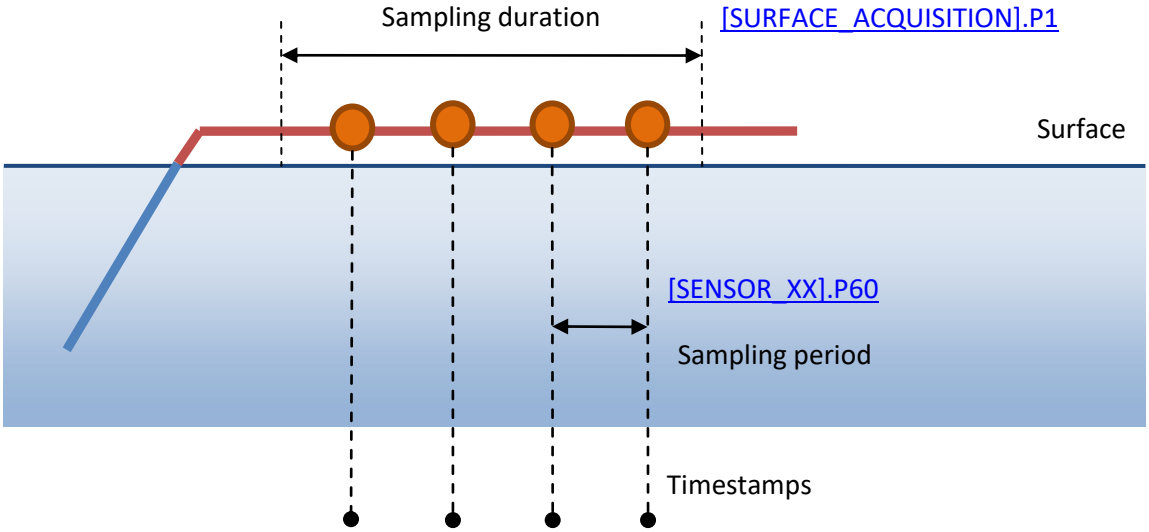
10.5.6. Standard deviation (0x04)

In "standard deviation" mode, the decimated data of the section are processed to calculate the standard deviation over the section.

10.6. Surface acquisition

In-air measurements can be achieved during the surface stage after the float had inflated its external bladder. This feature allows post correction of sensor's data.

This function can be activated by sensor and the surface sampling period set independently by sensor while the total acquisition time is common to all sensors.

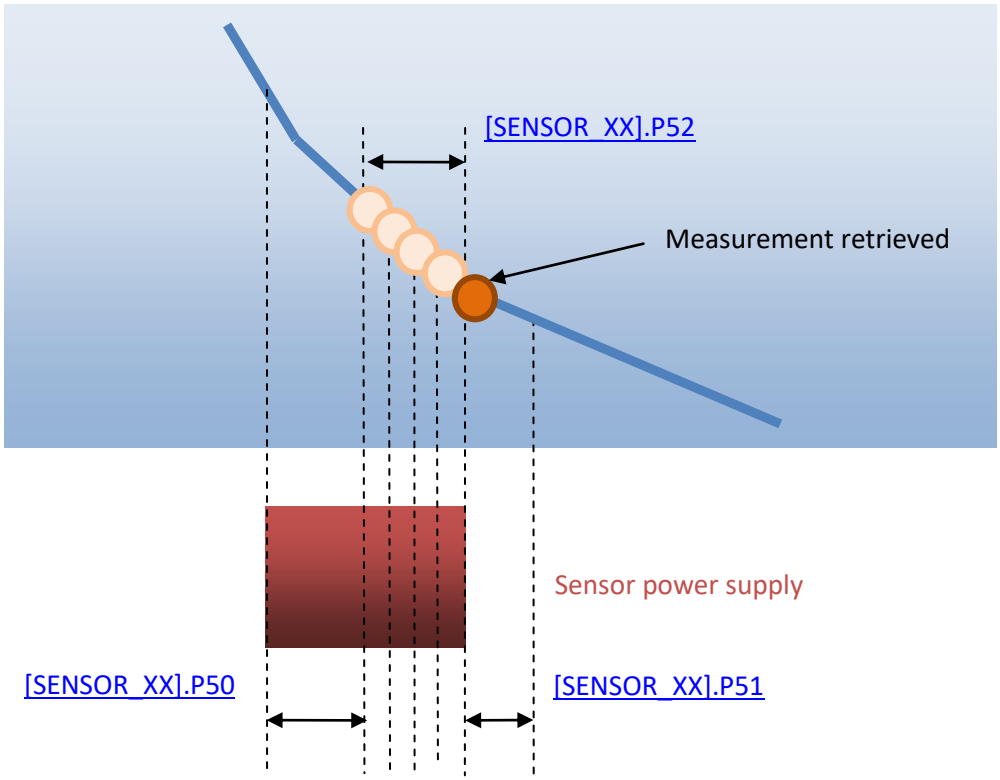


Note: During surface acquisition stage, the power supply control mode of zone 1 is applied to realise the acquisition.

10.7. Common specific parameters

The specific parameters of each sensor are managed independently according to the set of standard parameters:

- Warm-up time required by the sensor before taking measurements
- Shut down time required for the sensor to stop
- Measurement filtering index before considering that the measurements are correct



10.8. Identification of sensors

Following sensors can be embedded on float:

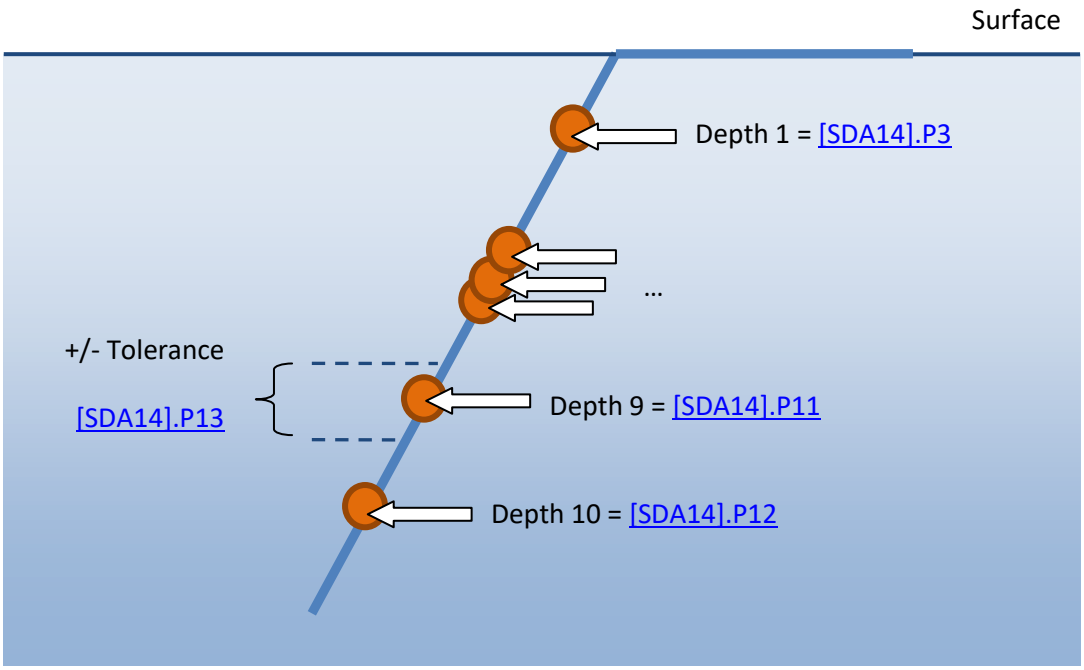
- SENSOR_01 : SBE41
- SENSOR_02 : DO
- SENSOR_03 : OCR (4,7 or 14 channels)
- SENSOR_04 : ECO (1,2 or 3 channels)
- SENSOR_05 : SBEPH
- SENSOR_06 : CROVER
- SENSOR_07 : SUNA
- SENSOR_08 : UVP6 LPM
- SENSOR_09 : UVP6 TAXO 1
- SENSOR_10 : UVP6 TAXO 2
- SENSOR_11 : UVP6 BLACK
- SENSOR_12 : ECOv2 (1,2,3 or 4 channels)

11. Specific sensors

11.1. Acoustic noise

11.1.1. Measurement in ascent phase

Environmental acoustic ambient noise measurements are performed while the float is ascending. When the vertical velocity of the float falls down and the pressure is within a tolerance of an acoustic depth (acoustic window) an acoustic sample is recorded.



During acoustic acquisition, no hydraulic action is achieved to ensure no internal noise from the float occurs.

User configuration must take into account the ascent average speed of the float when choosing the acoustic measurement depths. Close depth values can result in no data at a depth.

12. Extended features

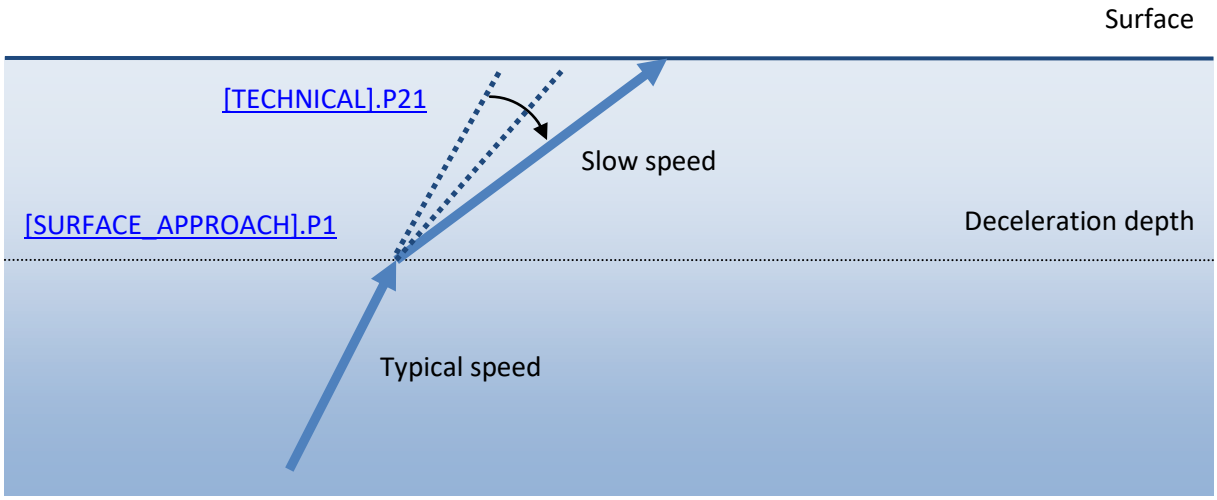
12.1. Ascent with "near-surface deceleration"

This type of pattern consists in decreasing the float's rate of ascent as it approaches the surface in order to increase the resolution of measurements.

The operation is as follows:

- Stage 1: "Standard" ascent to the deceleration depth
- Stage 2: "Slow" ascent to the surface

The “deceleration power” can be adjusted to obtain better results. The more the ascent speed is reduced, the more the ascent stage is extended.



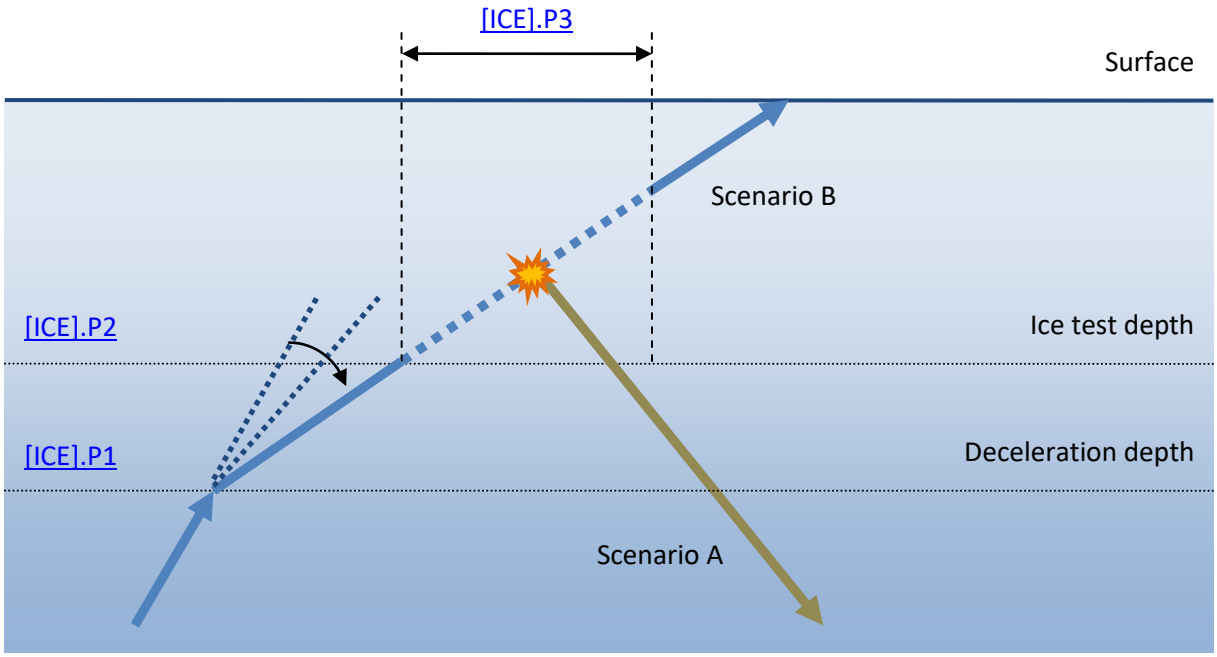
Note: The "end of ascent" detection threshold can interfere with the surface reached stage due to the fact that no further hydraulic action takes place during that stage (see explanations).

12.2. Ascent with "ice detection"

This type of pattern consists in dividing the ascent in different stages in order to allow the "measurement" to detect the presence of ice and to abort the pattern/cycle.

The operation is as follows:

- Stage 1: "Standard" ascent to the deceleration depth
- Stage 2: "Slow" ascent to ice detection test depth
- Stage 3: Waiting for ice detection
- Stage 4: Two possibilities
    - Scenario A: abort by the "measurement" and switch to the next pattern (or cycle)
    - Scenario B: the ascent resumes

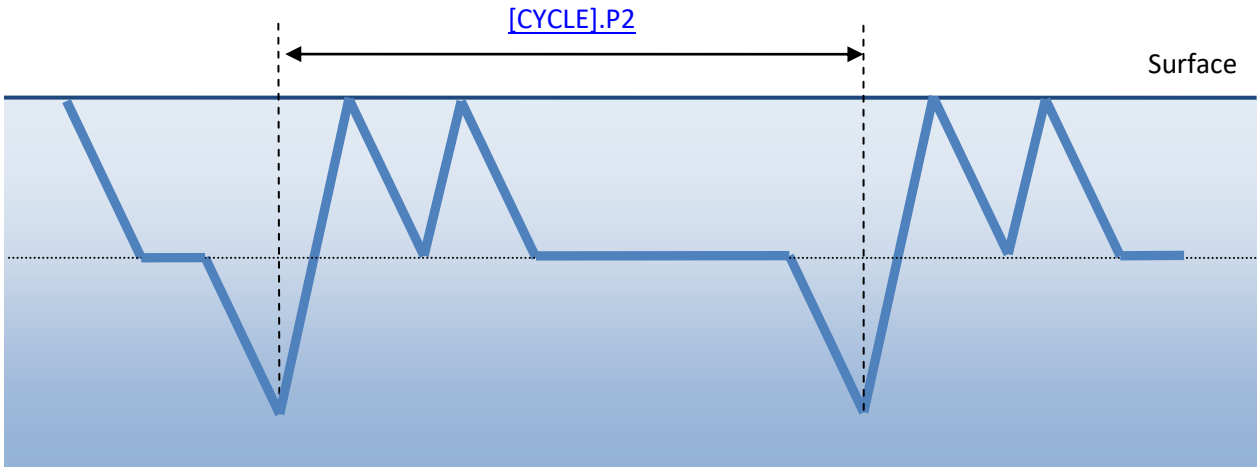


Note: The management of the hanging during ascent mode must be configured in "Abort emergence" mode to avoid a recovery ascent and switch to end of life in case ice is present at the surface.

12.3. Cycle periodicity

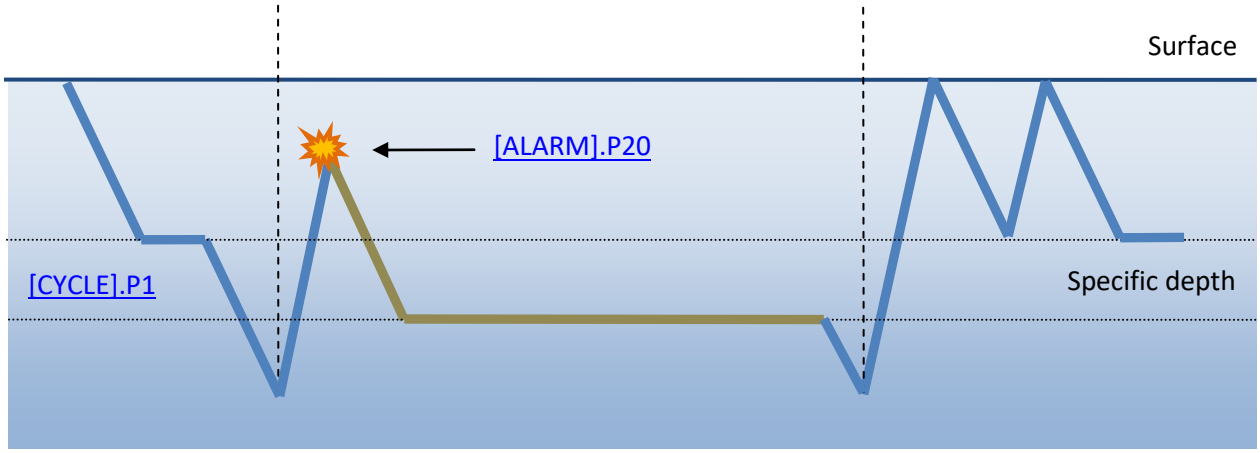
The sequence (cycle) management stage consists in ensuring cycle periodicity by recalculating the actual cycle time and adding drift to a specific parking depth if required.

12.3.1. "Standard" cycle



The interest becomes apparent when patterns have been aborted and/or when feedback control is added while the cycle is being executed.

12.3.2. Cycle interrupted by feedback

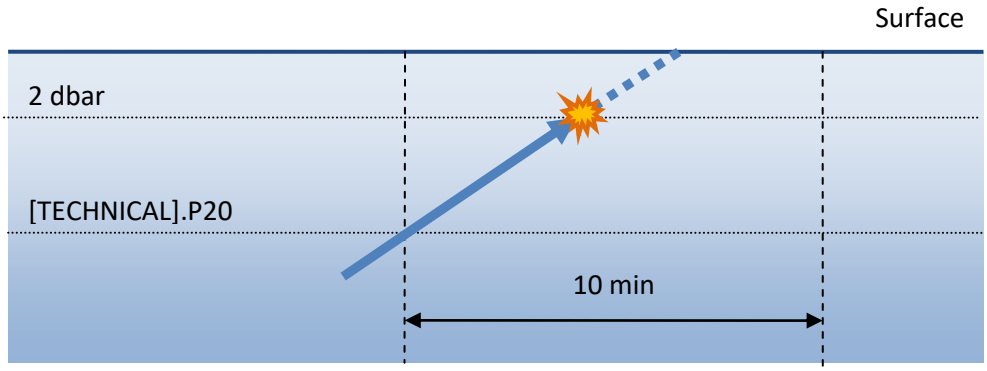


In case of feedback, the corresponding alarm is generated.

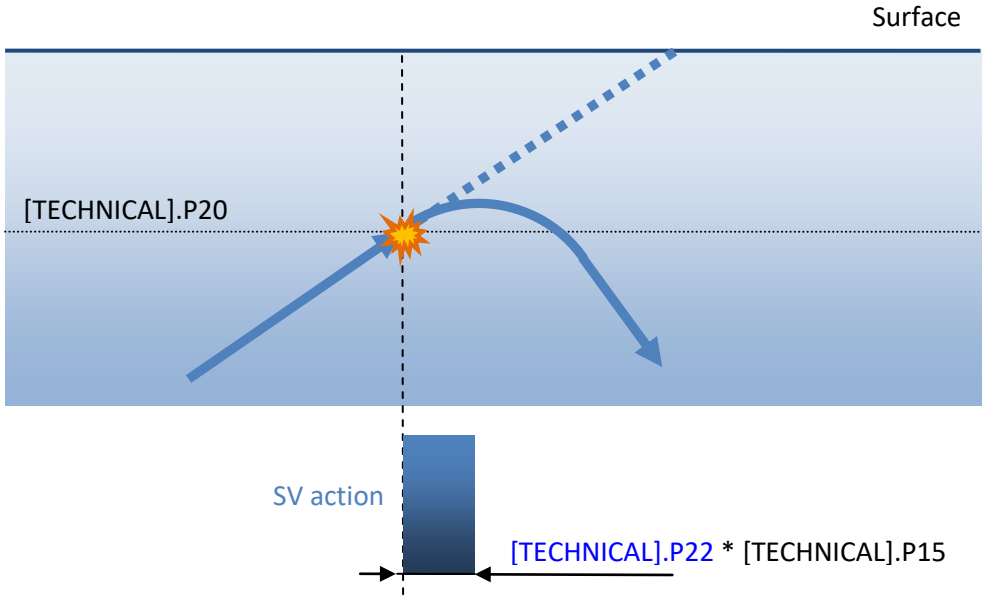
12.4. Special surface behaviours

The surface standard management can be improved with special behaviours in order to reduce the time spent in surface and/or avoid reaching the surface.

Parameter [SPECIAL].P0 is used to shorten the sub-surface phase by detecting the surface approach.



In case there is no surface session (GPS, Transmission ...), parameter [SPECIAL].P1 is used to move on descent phase directly without waiting for the end of the sub-surface phase. A hydraulic SV action is used to invert the float speed. The hydraulic action can be tuned to balance the last pump action (brake power).



12.5. Feedback

12.5.1. Principle

The feedback should allow the various tasks of the system to act on the course of the mission. The purpose of the main application is to give this possibility to the "measurement" in a dual-card (payload) environment.

The APMT "vector" must ensure the integrity of the float at all times and can therefore choose to limit and/or prohibit feedbacks.

12.5.2. Risk criterion

The risk criterion allows you to choose the maximum level of feedback that can be used during the mission.

This criterion incorporates the following limitations:

- Blocking of certain actions: action denied if the associated risk "R" is greater than the risk criterion "C" set
- Limit of successive actions over time: action denied if more than "N" actions have been accepted over less than the time period "T1"
- Limit of successive actions with no presence at the surface: action denied if there has been no presence at the surface for more than the time period "T2"

C	Risk level	N	T1	T2
0	No feedback	0	0	0
1	Low	1	1 day	3 days
2	Medium	3	1 day	7 days
3	High	9	1 day	30 days
4	Very high	9	1 day	400 days

12.5.3. List of feedback

The various possible feedback commands are associated with a level of risk (allows feedbacks greater than the risk criterion of the mission to be prohibited) as well as a list of "elementary" stages (during which feedback is possible).

Designation	R	Limitations
Anticipated profile	1	NC
Anticipated surface	1	NC, NE
Abort pattern	1	NB, NC, ND, NE, NF, NG, NH, NJ, NK, NL, TB
Abort cycle without transmission	1	NB, NC, ND, NE, NF, NG, NH, NJ, NK, NL, TB
Abort cycle with transmission	1	NB, NC, ND, NE, NF, NG, NJ, NK, NL, TB
Go to "depth"	2	NB, NC, ND, NE, NF, NG, NJ, NK, NL, TB
Typical navigation speed	2	NF, NJ, NK, NL
"Slow" navigation speed	2	NF, NJ, NK, NL

- **Anticipated profile**: immediate cancellation of the drift phase (parking depth)
- **Anticipated surface**: immediate cancellation of a drift phase (parking or measurement depth)
- **Abort pattern**: complete cancellation of the current pattern and loading of the next pattern
- **Abort cycle without transmission**: complete cancellation of the current cycle with no transmission, then loading of the next cycle
- **Abort cycle with transmission**: complete cancellation of the current cycle with ascent for transmission, then loading of the next cycle
- **Go to "depth"**: control assumed in pilot mode to reach a precise depth. The cycle in progress is aborted
- **"Slow" navigation speed**: application of the "slow" rate of ascent
- **Typical navigation speed**: restoration of the typical rate of ascent

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